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US Army Corps of Engineers
Rock Island District

DES MOINES RECREATIONAL RIVER AND GREENBELT

FEATURE DESIGN MEMORANDUM #8 WITH ENVIRONMENTAL ASSESSMENT

AD-A264 305

DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

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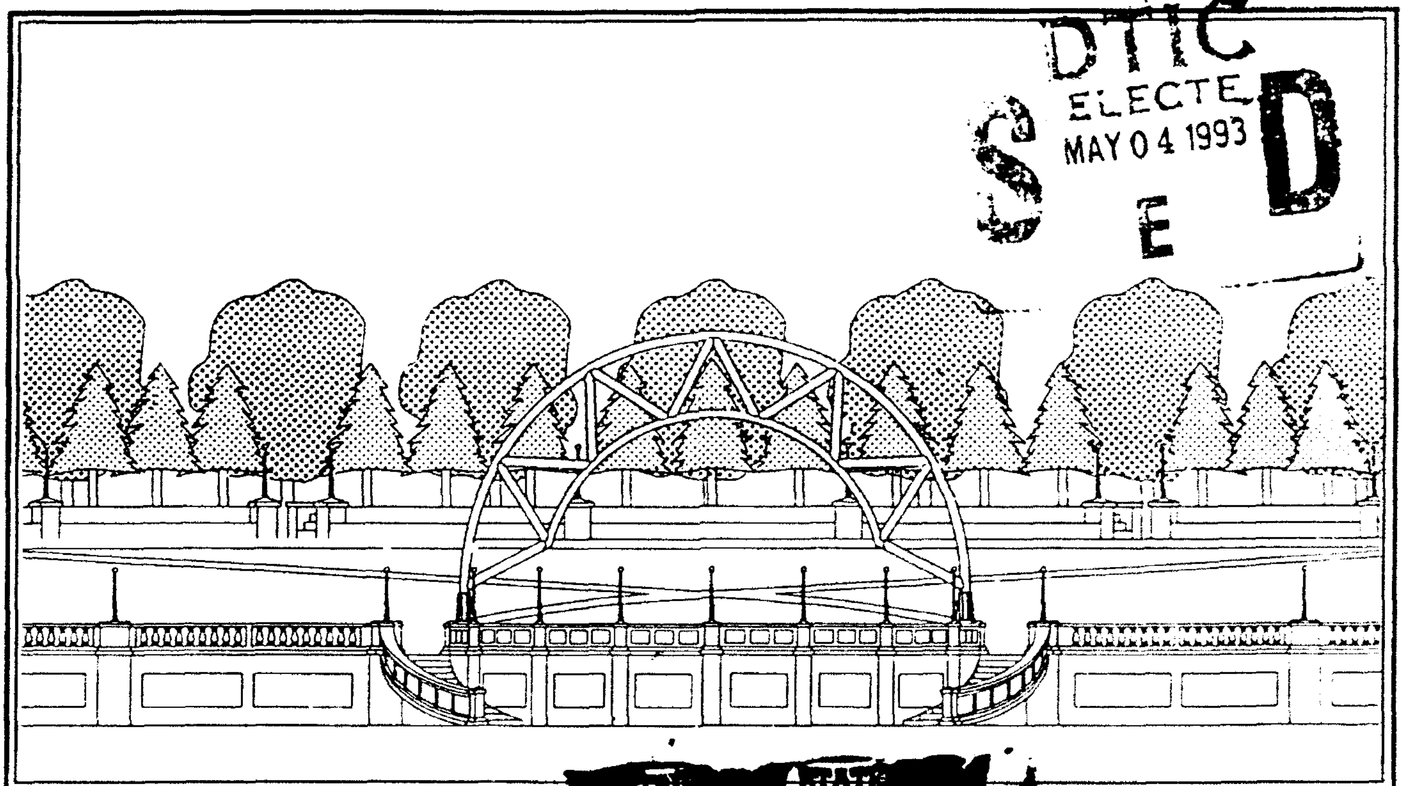
S E D



Approved for public release;
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REVISED AUGUST 1992

93-09420

CENCD-PE-ED-TM (CENCR-ED-DG/5 Jun 92) (1110) 3d End
Mr. Harris/cld/(312) 886-5463
SUBJECT: Des Moines Recreational River and Greenbelt, Iowa Project, Feature Design Memorandum No. 8 with Environmental Assessment - Downtown Riverfront Plaza/Amphitheater

Cdr, North Central Division, U.S. Army Corps of Engineers,
111 N. Canal St., Chicago, IL 60606-7205 SEP 9 1992

FOR Cdr, Rock Island District, ATTN: CENCR-ED-DG

1. Design memorandum No. 8 is approved subject to the comments at enclosure 6 and completion of the NEPA process.

2. Resolution of the comments at enclosure 6 will in no way impact the public review of FDM #8. The district should, therefore, proceed with public review in an effort to gain some time. Comment resolution should proceed concurrently with the public review.

3. The HQ, NCD, POC is Mr. Marvin Harris, CENCD-PE-ED-TM, (312) 886-5463.

FOR THE COMMANDER:

for JOHN P. D'ANIELLO, P.E.
Director, Engineering and
Planning Directorate

6 Encls
wd encls 1-5
Added 1 encl
6. as

CF (w/10 cys encl 1):
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CENCD-PE-ED-TM (1110) 8 September 1992

NCD 3D ENDORSEMENT COMMENTS
ON
FDM NO. 8
DES MOINES RECREATIONAL RIVER AND GREENBELT PROJECT

Geotechnical and Coastal Engineering

1. Comment 11e, 1st endorsement. The response to this comment is not satisfactory. Foundation and site soil conditions should be discussed in more detail. A proper development of construction materials begins with classification of site and foundation soils according to the Unified Soils Classification System. Once the classifications and appropriate testing is done, design parameters can be selected. Strength, settlement, permeability, and gradation are parameters significant to the design and should be properly developed. Toward this end, all future Greenbelt FDMs must include an adequate discussion of the site and foundation soils which will include detail coverage of subsurface and surface conditions to justify the foundation type selected. More detail on backfill/borrow regarding type required, quantities, and placement requirements should also be included.

General and Cost Engineering (additional comments)

2. Design Analysis. Prior to submittal of the plans and specifications, the complete design analysis for the amphitheater must be submitted for NCD review/approval.

3. Arch Structure Schematic. A schematic outline of the arch structure was included in the initial submittal of FDM #8 and was omitted from the August 1992 revision. This schematic should be included in the FDM to enable verification of the computer input.

4. Computer Input. A review of the dimensions of the Arch Foundation Plan shown on Sheet S-6 would indicate that the CPGA input will require revision to more accurately reflect the weight of the foundation and overburden. Similarly, the diagonal coordinates (x) listed on Plate D-51 must be revised.

ENCL 6

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT. CORPS OF ENGINEERS
CLOCK TOWER BUILDING—P.O. BOX 2004
ROCK ISLAND. ILLINOIS 61204-2004

REPLY TO
ATTENTION OF

CENCR-ED-DG 5 June 1992

MEMORANDUM FOR Commander, U.S. Army Engineer Division, North Central, ATTN: CENCD-PE-ED-TM, 111 North Canal Street, 12th Floor, Chicago, Illinois 60606-7206

SUBJECT: Des Moines Recreational River and Greenbelt, Iowa Project, Feature Design Memorandum No. 8 with Environmental Assessment - Downtown Riverfront Plaza/Amphitheater

1. The subject Feature Design Memorandum (FDM) is forwarded (10 copies for your review and release for the public review period (Encl 1). Your comments and release for public review are requested by 6 July 1992 in order to maintain the current approved schedule. Also forwarded is one complete M-CACES cost estimate (Encl 2) for the project. Cost information is also included in section 7 of the FDM.

2. A draft Local Cooperation Agreement has not been included as part of the FDM, but will be submitted separately at a later date after the FDM has been reviewed and released for public review.

3. Questions regarding the FDM may be directed to the Project Engineer, Mr. Perry Hubert, telephone 309/788-6361, ext. 6554.

FOR THE COMMANDER:

2 Encls

ROBERT W. KELLEY, P.E.
Chief, Engineering Division

CENCD-PE-ED-TM (CENCR-ED-DG/5 June 92) (1110) 1st End
Mr. Sauerman\mgb\(312) 886-5463
SUBJECT: Des Moines Recreational River and Greenbelt, Iowa Project, Feature Design Memorandum No. 8 with Environmental Assessment - Downtown Riverfront Plaza/Amphitheater

Commander, North Central Division, U.S. Army Corps of Engineers, 111 North Canal Street, Chicago, IL 60606-7205 13 JUL 1992

FOR Commander, Rock Island District, ATTN: CENCR-ED-DG

1. Approval is withheld pending resolution of the attached NCD comments and incorporation of necessary report revisions.

2. Significant concerns are design of the extended riverwalk support system as a circular SSP cell (Comment 8) and adequacy of the geotechnical appendix (Comment 11).

3. The HQ, NCD, POC is Mr. Ernie Sauerman, (312) 886-5463.

FOR THE COMMANDER:

3 Encls
wd encls 1-2
Added 1 encl
3. as

for JOHN P. D'ANIELLO, P.E.
Director, Engineering and
Planning Directorate

CENCR-ED-DG (CENCR-ED-DG/5 Jun 92) (1110) 2nd End
Mr. Hubert\sh\(309) 788-6361, ext. 6554
SUBJECT: Des Moines Recreational River and Greenbelt, Iowa Project, Feature Design Memorandum No. 8 with Environmental Assessment - Downtown Riverfront Plaza/Amphitheater

DA, Rock Island District, Corps of Engineers, Clock Tower Building, P.O. Box 2004, Rock Island, IL 61204-2004

14 August 1992

FOR Commander, U.S. Army Engineering Division, North Central, ATTN: CENCD-PE-ED-TM, 111 North Canal Street, 12th Floor, Chicago, Illinois 60606-7206

1. The subject Feature Design Memorandum (FDM) has been revised in response to NCD comments. Your comments together with responses are attached. Also attached, please find 13 copies of the revised FDM for your approval, release for public review, and coordination with HQUSACE for their review of the approved FDM.

2. The majority of the responses have been coordinated informally with the NCD reviewers through your office. The extended riverwalk support system has been redesigned and the geotechnical appendix was revised. The structural design analysis, Appendix D, has been completely revised in response to PE-ED-TT comments.

3. FDM approval/release for public review is requested as soon as possible to maintain the approved schedule.

4. A draft Local Cooperation Agreement is being coordinated with the local sponsor. The LCA package will be forwarded for NCD review after FDM approval.

5. Questions regarding the FDM may be directed to the Project Engineer, Mr. Perry Hubert, telephone (309) 788-6361, ext. 6554.

FOR THE COMMANDER:

5 Encls
wd encl 3
Added 2 encls
4 and 5. as

ROBERT W. KELLEY, P.E.
Chief, Engineering Division

CENCR-ED-DG

14 August 1992
Mr. Hubert/sh/6554

SUBJECT: Response to NCD's Comments to Draft FDM No. 8, Downtown Riverfront Plaza/Amphitheater, Des Moines Recreational River and Greenbelt, Iowa

PE-PD-ER Comment:

1. COMMENT: The EA must address impacts to the borrow/disposal sites, and transport of materials to and from the sites. If the borrow area was previously addressed in an EA, that should be stated in this EA. Use of commercial disposal sites does not alleviate the need for impact assessment in this EA.

1. RESPONSE: The following paragraph has been added to paragraph 3f(1) of the EA - The borrow site which will be used to obtain fill material (see Plate 1) has been and is currently used by the City of Des Moines as a borrow source for other projects. The effects of borrow activities on this area were previously addressed in the Final Supplement No. 1 to the Final Environmental Impact Statement (FEIS) for the General Reevaluation Report for the Local Flood Control Project on Raccoon River and Walnut Creek, West Des Moines and Des Moines, Iowa (July 1989). The disposal sites are currently being used for disposal for other City projects and no adverse impacts are anticipated to result from their use for this project.

PE-ED-TT Comments:

2. COMMENT: Appendix D. Structural calculations have not been checked. The input for the GT STRUDL lists dimensions to the outside of the 12" diameter pipe. Verify that the centerline need not be used. Sheet S-5, Arch Plan View, shows center to center dimension of 56'-11.25". It should be 57', because the outside dimension of the pipe is equal to 12". Explain the function of HP 14*73 indicated on the Support Detail.

2. RESPONSE: Appendix D has been completely revised. All structural calculations have been checked. The arch was modelled correctly; however, the center of the arch should be dimensioned rather than the outside as shown on the drawings. The HP14x73 has been deleted from the support detail. Plates 13, 14, and 15 were modified to reflect these changes.

3. COMMENT: The stress calculations are performed for 1/4" thick aluminum pipe without the computer run. It is recommended that the analysis be rerun on the computer with the reduced pipe thickness prior to preparation of plans and specifications, to verify that actual stresses remain below allowables.

3. RESPONSE: The correct section properties have been used in the revised FDM. The analysis was rerun to reflect the changes required for comment 5 and the section properties reflect the latest design.

4. COMMENT: Arch foundation was analyzed with a 3'-6" c/c pile spacing. Sheet S-6 indicates 4'-0" c/c in the east west direction and 3'-6" in the perpendicular direction. Reconcile and revise as necessary.

4. RESPONSE: Both Appendix D and Plate 16 have been revised to reflect the latest analysis.

5. COMMENT: Design is needed for arch supports, anchor bolts, base plates, concrete pier and the pile cap. Consider use of sliding support at one end. Note that if all supports remain fixed, temperature effects on the arch need to be considered.

5. RESPONSE: The design analysis in the FDM is supposed to provide design criteria and representative design calculations in accordance with CENCD-PE-TT Memorandum dated 28 Jan 1992. Design of details was not called for. The revised FDM includes a design which takes into account the affects of thermal expansion. The structural model was revised to include the concrete piers and an additional thermal load of 100 degrees F temperature change was added. This additional load was combined with the other load cases as well. Since the concrete piers were able to translate somewhat in the horizontal direction and the geometry of the arch allowed it to deflect vertically to accommodate the arch expansion, no stresses developed which are above the computed allowable stress. Appendix D has been revised to reflect these changes.

6. COMMENT: Retaining Wall Design, Plate D-65, assumed bottom of foundation E1.791 and top of stem at E1.803.8, while Drawing S-8, shows top of wall at E1.802.8 and bottom of foundation varying from E1.785 to E1.793. Verify that the assumed cross-section will be sufficient for the highest backfill level on the tallest wall. Analyze effect of wall foundation loads on existing sewer below.

6. RESPONSE: The most conservative section was chosen for analysis. The section of wall closest to the river receives no surcharge from Locust Street or the sidewalk along locust street and does not have much of a difference between the

backfills on its heel and toe. The middle section was used because it is exposed to the surcharge described above and the greatest differences in the elevation of its backfills. The retaining wall should have no impact on the existing sewer. The sewer lies outside the area which is affected by load on the foundation of the wall. In addition, the construction of the retaining wall will allow for removal of the embankment. The net affect will be reduction of load on the existing sewer.

7. COMMENT: Plate D-67 (calculations) should consider the requirement of EM 1110-2-2502, Paragraph 3-8.b. which states that "In no case should the resisting side earth pressure exceed one-half the passive pressure...".

7. RESPONSE: Concur. This change has been made to Appendix D in the revised FDM. The calculations show that no changes to the wall section are needed.

8. The design of the extended riverwalk support system as a circular SSP cell is inadequate.

a. COMMENT: The structure is not a complete cell and the contained soil is limited in volume and will not generate sufficient lateral soil pressure to put the SSP interlocks into tension which is needed to develop shear resistance along the interlocks. Without shear resistance along the interlocks, the structure does not act as a cell. Please note the SSP cells use PS sections which are straight and when driven in a circle are forced into tension rather than bending. Here we use PZ SSP sections which will respond to load as a flexural vertical member. In addition, analysis of the SSP as a vertical member has not been provided. The SSP is being made to carry the vertical weight of the concrete riverwalk. Vertical loads induce compressive forces on the SSP sections, and combined axial and bending stresses need to be considered. A combination of vertical load and bending due to ice forces could buckle the SSP. Provide additional analysis to address the above concerns.

a. RESPONSE: The extended riverwalk has been redesigned using battered bearting piles driven to refusal. Appendix D has been revised to reflect these changes.

b. COMMENT: One option to support the extended riverwalk and eliminate the cell-type structure would be to continue the concrete grade beams and slab and support them at the river end with steel H-piles driven to rock. SSP could then be driven on the outside of the H-piles to provide subgrade protection from erosion and ice.

b. RESPONSE: This type of structure will be utilized as shown in Appendix D and Plates 12 and 13.

9. COMMENT: The 30 & 31 Accounts of the Cost Estimate are not in sufficient detail to allow for complete review. Percentages appear to be in the correct order of magnitude. Future Greenbelt submittals will be required to provide more levels at detail. Remaining portions of the estimate are acceptable.

9. RESPONSE: Table 7-1 has been revised to include more detail concerning the 30 and 31 accounts and also to revise the 14 account detailed in Table 7-2 which was revised to reflect the structural design changes for the extended riverwalk support system.

10. COMMENT: Add the contingency analysis backup for the cost estimate to the report.

10. RESPONSE: This has been included on page 24 in the revised FDM.

PE-ED-TG Comments:

11. Pages C-1 and C-2. The geotechnical portion of this report is inadequate. The section should include the following: [Note-Appendix C has been revised to address the reviewers' concerns along with the responses which follow.]

a. COMMENT: Recommended soil and bedrock values to be used by designers.

a. RESPONSE: Because of the extremely low blow counts of 1 to 4, it was decided to use end bearing piles. For this reason, soil values were not needed. Blow counts of 5 or below indicate a very loose condition. For sand with blow counts below 10, the sand must be compacted before a structure can be built. Bearing pressures for these soil types range from 1-2 tsf for the upper, finer grained material; to 4-6 tsf for the coarser glacial materials.

The compressive strength of the bedrock tested was 1817 psi for the shale and ranged from 10,324 to 12,198 psi for the siltstone. Typical bearing pressures for this type rock is between 10 and 20 tsf. Due to the interbedded nature of the rock, it is anticipated that piles will probably achieve refusal within 2-3 feet penetration of the siltstone. As shown on plate D-44 the strengths supplied by the Geotechnical Branch for design are phi of 51 degrees and a q_u of 2000 psi; however, the governing factor is the capacity of the pile.

b. COMMENT: A discussion of alternative types of foundations including pros and cons of each.

b. RESPONSE: See the response to comment No. 12.

c. COMMENT: Allowable bearing capacity for soil and bedrock.

c. RESPONSE: See the response to comment 11(a) above.

d. COMMENT: A discussion of possible settlement, drainage, seepage, etc.

d. RESPONSE: Because the structure will be built on piles founded on bedrock, settlement is not a concern. Drainage concerns have been addressed in the Hydrology and Hydraulics Appendix on pages E-2 and E-3. The levee in this reach is 3.7 feet in height and was designed with 3 feet of freeboard. In the event there is a design flood, the hydraulic head will only be 0.7 feet. Therefore, no seepage distress is expected.

e. COMMENT: A complete discussion of materials; foundation materials, backfill, fill, etc.

e. RESPONSE: The foundation materials have been discussed above. Backfill material will come from the excavated material on the project site so long as the on-site material is suitable. Fill should not be required, but if fill is required, it will be obtained from a previously tested and approved borrow area shown on Plate 1. This same borrow area was used for construction of the Des Moines LFPP and was recently approved by NCD in the Definite Project Report, Section 205 Flood Control Project, Raccoon River, Des Moines, Iowa.

12. Plates D-52 and D-99

a. COMMENT: Justify using a pile foundation. Show that the bearing capacity factor of safety for spread footings and possibly concrete columns is not adequate.

a. RESPONSE: A pile foundation was chosen for both the arch and stage foundation to minimize the impact on the existing sewer and riverwall. A spread footing would place both vertical and horizontal load on the existing structures. The use of piles will carry most of the load to bedrock.

b. COMMENT: Show that pipe piles are the most economical and functional. Compare to other pile types and compacted granular fill.

b. RESPONSE: Steel pipe piles are being used for several reasons: 1) since the structure will take load from all directions, the piles need to be strong in all

directions and of course a circular section satisfies this criteria; 2) since a pipe is hollow, a pipe pile is essentially a non-displacement pile which will minimize the affect of the pile driving on the existing structure.

13. COMMENT: Plate D-58. Discuss lateral loads on piles.

13. RESPONSE: CPGA was used to compute the lateral and axial loads on the piles as well as moments and stresses in the pile. The coefficient for horizontal subgrade reaction was computed using techniques developed by Dr. Carl Terzaghi to calculate n_h for loose sand. A lateral deflection of .05 inches was computed which should not pose a problem for the existing structure.

14. COMMENT: Plate D-65, D-68 and D-103. The phi = 25 deg. is very conservative. A minimum of 30 deg. and possibly 32 deg. is recommended for footing design. Redo to see if a more economical retaining wall section results.

14. RESPONSE: Plates D-65 and D-68 - Overturning is governing the design of the retaining wall and therefore increasing Phi from 25 to 30 deg. for the foundation material will not change the overturning stability of the wall. However, the analysis has been revised and the phi angle has been changed to 30 degrees.

14. RESPONSE: Plate D-103 - Since the extended riverwalk has been redesigned, this comment no longer is applicable.

15. COMMENT: Plate D-74. The phi = 27 deg. is too conservative. Redo using phi = 30 deg. or 32 deg.

15. RESPONSE: Since the foundation capacity is not governing the size of the retaining wall base, the use of phi= 30 in lieu of phi= 27 will not result in a less costly structure. However, the analysis has been revised using phi = 30 degrees.

<u>PE-PD-EC Comments</u>:

16. COMMENT, Part 1: It is not clear from the economic analysis that the benefits attributed to the project represent the net increase in the value of the recreation experiences over the without project condition. Although UDV increases are used, there is no comparison of recreational activity with and without the project.

16. RESPONSE, Part 1:

a. The Unit Day Value increases were based upon the comparison of (a) having an activity or event at the site in its existing condition and the improvement based upon the "with project" condition (e.g. picnicking); (b) having a new event at the Amphitheater site in the "without" and "with" condition, (c) having an event relocated to the Amphitheater site, and (d) the "without" and "with" project condition of this portion of the existing East River Bike Trail.

b. No recreational activity comparison was spelled out in the report as it was assumed by the economist that a specific type of recreational activity would lend itself to the Plaza site, or not. The types of events which might be held there were cited in 8.e.(1)(d) and detailed in Figure 8-3. As most of the recreational activities sponsored by the Des Moines Park and Recreation Department are held at the various Community Centers throughout Des Moines, the Plaza would merely be an additional site for recreational events to be held. For instance, it was assumed that the Hot Air Balloon Rides would not be held at the Amphitheater Plaza site, nor would the outdoor volleyball or basketball games be held there, the same for billiards and gymnasium workouts.

16. COMMENT, Part 2: In some cases new opportunities are being developed, but not in all. For instance, there are concerts, fireworks displays, and other festivals now taking place. Also, the report should consider which activities now taking place in the study area would be replaced by those associated with the project and net these out from the benefits.

16. RESPONSE, Part 2:

a. Less than two or three events will be relocated to the Amphitheater site. Virtually all of the events and activities to be held at the Amphitheater site will be new. No comparison of recreational activity attendance with and without project was made for the few activities which are merely being relocated from elsewhere within the City of Des Moines to the Amphitheater/Riverfront Plaza site.

b. Benefits are based upon the UDV for the "with project" condition less the UDV for the "without project" condition, or on the "net increase" in the UDV, not in increased attendance for the events merely because they will be held at the Amphitheater site.

c. For those recreational activities which are "new" activities or events, the assumption was made that attendance at these new events or activities would be similar to attendance from prior years at similar types of

events or activities. It was assumed that any low attendance for a specific event or activity would result in that specific event being replaced with another, and not in the elimination of that type or category of event.

d. The projected usage is based upon information provided by the City of Des Moines official representatives based upon prior year's records. No estimated "increases" in attendance because of the recreational activity being held at the Amphitheater/Plaza instead of being held elsewhere were made. The only "projected" attendance estimates were for additional events or activities to be held at the proposed Amphitheater/Plaza, as would normally be projected by any City if it were constructing an additional recreational facility.

e. As stated in 8.e.(1)(c), estimated use was based upon data received from the City of Des Moines Planning Department, records of past attendance from the Park and Recreation Department, and other local sources based upon attendance at similar events held in the past, and their estimates of projected attendance for future events. Table 8-7 set out the estimated attendance, all of which was conservative. For instance, 8.e.(1)(c) states that a total of 23,000 persons (an average of 2800 persons at each event) attended the jazz concerts held in 1990. Table 8-7 uses a range of from 750 to 1000 persons per event, or almost 2/3rds less. The Des Moines City Manager's Newsletter, Spring 1992 issue reported that more than 1,000 bicyclists participated with the Mayor in the Mayor's Annual Bike Ride. Table 8-7's estimated range for this event is 200-500 people, less than half the number of actual participants.

16. COMMENT, Part 3: Because there is uncertainty associated with the analysis in the report, there is also uncertainty associated with the benefits.

16. RESPONSE, Part 3: Uncertainty associated with the benefits is somewhat alleviated because all attendance estimates were conservative and, in many instances, low.

17. COMMENT: The purpose of the sensitivity analysis is to test the effects of changes in the major assumptions, variables and analysis parameters on the decision variable (i.e., net benefits). In this case, there are key variables which are highly judgmental, projected usage and UDVs, which should be the object of the sensitivity analysis. The report is inadequate in this regard.

17. RESPONSE:

a. To clarify one of the "uncertainties": the value points assigned the various criteria. The rationale behind the judgment factor value points for the three categories of

recreation for a "without project" condition are given in the following tables. The UDV information was based upon the "Guidelines for Assigning Points for General Recreation" ER 1105-2-100, 28 Dec 90.

Table 1
Criteria Judgment Factor Points - Without Project
PICNICKERS

Criteria	Points	Judgment Factors
Recreation Experience	2	Two general activities--too little room between hotel and levee. Riverward: mowed weed patch, subject to drought; mud, soggy ground when it rains; small runoff gully; steep slopes.
Availability of Opportunity	2	Have to walk 8-10 blocks (one way) to picnic sites...too far for lunch hour crowd. Not within 30 min. round trip walking distance, unless eat on way.
Carrying Capacity	1	"Minimum facility" as is.
Accessibility	6	High standard roads to site, but very limited access within site. No access to site or within site for handicapped.
Environmental	1.5	Right on street level. Drought ravaged vegetation; small runoff gullies because of drought. Great view of levee and hotel wall. Only view of river if climb to top of or over levee. One scraggly tree.
TOTAL POINTS:	12.5	

Table 2
Criteria Judgment Factor Points - Without Project
AMPHITHEATER

Criteria	Points	Judgment Factors
Recreation Experience	2	Two general activities--too little room between hotel and levee. Not feasible for concerts, enjoyable picnicking, entertainment. Physical limitations of site preclude varied usage.

Availability of Opportunity	1	No other outdoor amphitheater within a one hour driving time of the City of Des Moines. A "natural" outdoor amphitheater is located approximately 90-minute drive away (one-way).
Carrying Capacity	1	"Minimum facility" as is. Could have strolling musicians or entertainers in the narrow space between the levee and the hotel wall, if desperate.
Accessi-bility	6	High standard roads to site, but very limited access within site. No access to site or within site for handicapped.
Environ-mental	1	View of levee blocks view of river. Drought ravaged vegetation; runoff gullies because of drought. Great view of hotel wall. Only view of river if climb to top of or over levee. At extreme edge of site, one 12-inch diameter tree for sparse shade.
TOTAL POINTS:	11	

Table 3
<u>Criteria Judgment Factor Points - Without Project</u>
<u>CYCLISTS, HIKERS, WALKERS, ETC.</u>

Criteria	Points	Judgment Factors
Recreation Experience	3	Two general activities--too little room between hotel and levee. Physical limitations of site preclude varied usage.
Availability of Opportunity	3	Proposed plaza site is already part of the existing East River Bike Trail and is an approximate 10-foot wide sidewalk.
Carrying Capacity	4	Basic facility to conduct activity. Using vegetated riverbank to access the lower River Walkway could result in deterioration of riverbank dependent on weather conditions.

Accessi- bility	6	High standard roads to site, but very limited access within site. No access to site or within site for handicapped.
Environ- mental	5	Average aesthetic quality; factors exist that lower quality to minor degree. Only view of river if climb to top of or over levee. Some
hikers,		walkers, cyclists may wish to climb to the top or over the levee.

TOTAL POINTS: 21

b. Since the Guidelines do not specify that the reasoning behind the judgment factor point values for the "without project" condition be detailed, this was not included; the rationale being that any questions with the judgment factor value points would have been answered during the "in house" review.

c. The Sensitivity Analysis has been revised to include a table showing BCR's for low and high attendance figures detailed in the report. Using the low figure results in a BCR of 0.97 and the high attendance figures have a BCR of 1.70.

CENCR-ED-DG

DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM NO. 8
WITH ENVIRONMENTAL ASSESSMENT

DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER

DES MOINES, IOWA

REVISED AUGUST 1992

ACKNOWLEDGEMENTS

Project Engineer	Perry A. Hubert
Architectural Analysis	Cal Lewis, HLKB Architecture Patricia Zingsheim, City of Des Moines Carmelo Senatra
Structural Analysis	Tom Wirtz Wen Tsau
Geotechnical Analysis	Glen Hotchkiss George Millar
Cost Estimate	Mike Cummings Joseph H. Ross
Technicians	John Gall Harry Galley John Kempter Bob Simonton Dave Simpson John Quick
Environmental Analysis	Charlene Carmack
Cultural Resources	Ronald Deiss
Economic and Social Analysis	Louise Zawlocki
Real Estate	Bob Lazenby
Hydraulic Analysis	Marv Martens Roland Fraser

DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM NO. 8
WITH ENVIRONMENTAL ASSESSMENT

DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER

DES MOINES, IOWA

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DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM NO. 8
WITH ENVIRONMENTAL ASSESSMENT

DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER

DES MOINES, IOWA

1. INTRODUCTION

a. Project Authority

The Des Moines Recreational River and Greenbelt (hereinafter referred to as the Greenbelt) was funded and authorized by Public Law 99-88 as approved on August 15, 1985. The project calls for the development, operation, and maintenance of a recreational area on, and along, the Des Moines and Boone Rivers from Fort Dodge and Webster City, Iowa, downstream to relocated U.S. Highway 92 in the vicinity of the Red Rock Dam. The Downtown Riverfront Plaza/Amphitheater is one of several Greenbelt projects (hereinafter referred to as the Amphitheater).

b. Purpose and Scope

The purpose of this report is to establish the project requirements and to evaluate the project on the basis of engineering, economic, and environmental viability. The report includes a project description, engineering considerations, economic analysis, environmental assessment, and sufficient construction details to allow preparation of plans and specifications to proceed during the review and approval process.

c. General Design Memorandum

The General Design Memorandum (GDM) for the Greenbelt (September 1987) covers the administration, comprehensive plan, plan for initial development and coordination of the overall Greenbelt, and discusses the conditions for Federal participation. The comprehensive plan addresses the entire Greenbelt. The Amphitheater project is one of the projects included in the comprehensive plan. The GDM project number of the Amphitheater is 301.2.

d. Other Reports

A list of Feature Design Memorandum (FDM) prepared for other Greenbelt projects follows:

FDM #1 - Bennington Bridge Access - May 1986
FDM #2 - Jester Park Campground Improvements - August 1989
FDM #3 - Multi-Purpose Trail, Red Rock, Segment I - May 1989
FDM #4 - Lutheran Hospital Bike Trail Segment - March 1990
FDM #5 - Dragoon Trail Scenic Road Route - October 1991
FDM #6 - Multi-Purpose Trail, Red Rock, Segment II - March 1991
FDM #7 - Hamilton County Scenic Overlooks - Cancelled

e. Advisory Committee

An advisory committee was established in accordance with the Conference Report on H.R. 2577, dated July 29, 1985. This committee is composed of local officials from the cities, counties, and state governments in the Greenbelt project areas as well as from the Corps of Engineers. At their January 19, 1990 meeting, the advisory committee recommended four separable projects, including the Amphitheater project, to the Corps of Engineers for construction.

f. Principles and Guidelines

Principles and Guidelines activities were accomplished by a combination of activities documented in the September 1987 General Design Memorandum (GDM) and Programmatic Environmental Impact Statement (PEIS), in the workings of the Advisory Committee, and in this report. A number of alternatives for the overall project were addressed in the PEIS and the plans were formulated in the GDM for each separable element in coordination with the local sponsors and the Advisory Committee. Extensive public involvement activities and public meetings have been conducted on a continuing basis under the guidance of the Advisory Committee.

g. Local Sponsor

The local sponsor is the City of Des Moines, Iowa.

2. DESCRIPTION OF PROJECT

a. Project Location

The project area is located within Section 4, Township 78 North, Range 24 West, Polk County, Iowa (1956 Des Moines 7.5' U.S.G.S. quadrangle) along the left (east) bank of the Des Moines River between East Locust Street and East Walnut Street in downtown Des Moines, Iowa just upstream of river mile 202 (Figure 1). The site is approximately one acre in size and is owned by the City of Des Moines.

b. Project Description

(1) The project involves construction of a public outdoor amphitheater and public gathering area to serve as a park on the riverfront in downtown Des Moines. A round stage will intersect the existing Des Moines Riverwall and will span over the existing interceptor sewer/riverwalk. An extended riverwalk will protrude approximately 26 feet beyond the existing interceptor sewer into the Des Moines River. An arch (approximately 57'W x 37'H) constructed of 12" tubular aluminium spans over the stage and serves as the focal point of the project as well as a support for user-furnished stage lighting, sound systems, banners, and decorations.

(2) The spectator area consists of formed grass slopes with concrete steps and walks rising to a concrete planter which doubles as a small floodwall to replace the upper 2.8 feet of the existing levee which is part of the Des Moines Local Flood Protection Project (LFPP). East of the planter is a tree-lined plaza with seating adjacent to selected trees. A segment of the Des Moines Bike Path runs along the east edge of the site adjacent to the Embassy Suites.

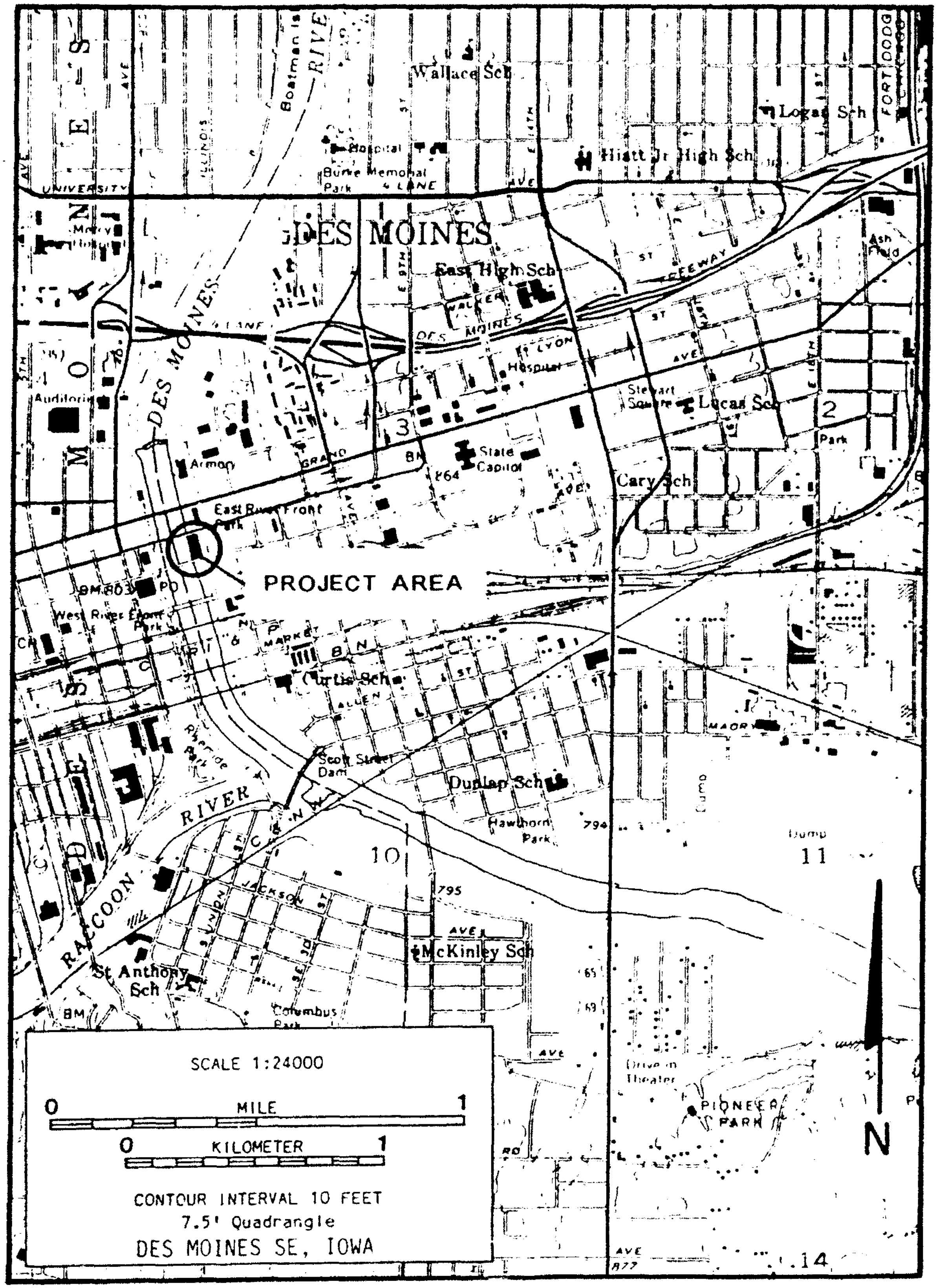

Figure 1-1 Location of project area

3. ENVIRONMENTAL ASSESSMENT

a. Purpose and Alternatives

(1) The purpose of this environmental assessment is to address the effects of construction of the amphitheater as described in Section 2 of this report. Alternatives to the proposed action include the no Federal action alternative, and other designs for construction of the plaza and stage components of the amphitheater.

(2) The selected design will be constructed within previously developed or disturbed areas on an urban site. With no Federal action, no project impacts would occur; however, no long-term recreation benefits would be expected. Preliminary review of alternative design strategies for amphitheater construction indicates that these alternatives would be expected to have impacts similar to or greater than the preferred alternative, or would be less economically feasible.

b. Major Findings and Conclusions

The project is expected to be beneficial to recreation resources in downtown Des Moines with no significant impacts to natural, cultural, economic or social resources. For this reason, an Environmental Impact Statement (EIS) will not be prepared for this action. Because the project involves construction in the Des Moines River, a 404(b)(1) Evaluation will be required for compliance with the provisions of the Clean Water Act (See Appendix B).

c. Relationship to Environmental Requirements

(1) The project will comply with Federal environmental laws, Executive orders and policies, and State and local policies including the Clean Air Act, as amended; the Clean Water Act, as amended; the Endangered Species Act of 1973, as amended; the Federal Water Project Recreation Act; the Fish and Wildlife Coordination Act of 1958, as amended; the Land and Water Conservation Fund Act of 1966, as amended; the National Environmental Policy Act of 1969, as amended; and the National Historic Preservation Act of 1966, as amended.

(2) The proposed work will take place primarily within a previously developed or disturbed urban setting and will not result in the conversion of farmland to other uses. This segment of the Des Moines River is not a Federally recognized wild or scenic river. No loss of wetlands will occur from construction or operation. Therefore, this action will not conflict with the provisions of the Farmland Protection Policy Act of 1981; Executive Order

11990, Protection of Wetlands, or the Wild and Scenic Rivers Act of 1968.

(3) The proposed action will not increase flood profiles to an extent that would compromise the level of protection provided by the Des Moines Local Flood Protection Project. Therefore, the project is determined to be in compliance with Executive Order 11988, Floodplain Management.

d. Affected Environment

(1) The site of proposed amphitheater construction is a 1-acre tract of land located on the left descending bank of the Des Moines River between Locust and Walnut Streets in the city of Des Moines. The area surrounding the project site is primarily in commercial and public use. A segment of levee which is part of the Des Moines Local Flood Protection project traverses the eastern third of the project site on an alignment parallel to the river. In addition, a portion of the Des Moines bicycle trail runs between the levee and the Embassy Suites hotel property to the east.

(2) Vegetation on the site consists of mowed turfgrass and a single oak tree in the southeast corner of the parcel. The small size of the project site, lack of vegetative diversity and location in an urban setting severely limit its value as terrestrial habitat. Wildlife occurrence in the project area would likely be limited to species having high tolerance of urban conditions and human disturbance. This could include songbirds such as house sparrows, European starlings, American robins, rock doves and grackles; mallards; and small mammals such as mice, shrews, voles and rabbits.

e. Affected Cultural Resources

(1) The west (riverward) side of the site is bounded by a portion of the Des Moines Riverwall and walkway. This structure is included as a portion of the National Register of Historic Places Civic Center Historic District (Historic District) within the City of Des Moines (City). The Historic District is a significant example of late 19th and early 20th century riverine community planning and development following progressive national trends, although 20th century river use has been low due to limited access and minimal attraction. According to the Historic District nomination form on file at the SHPO, the riverwall is concrete and consists of an ornamental balustrade, interceptor sewer, fill soil, and incomplete sections of earlier attempts to confine the river.

(2) On December 21, 1990, the Iowa State Historic Preservation Officer (SHPO) concurred with the Rock Island District of the U.S. Army Corps of Engineers (Corps) and the City recommendation for an archaeological survey and reconnaissance to document and identify the presence of buried significant historic properties within the proposed project and borrow areas. The SHPO also stated that the project may affect the Historic District riverwall.

f. Environmental Effects

(1) Construction of the amphitheater will result in the loss of some herbaceous vegetation. The small size of the project area, lack of a natural vegetation community, and its location in a downtown urban setting drastically limit its potential wildlife habitat value. The existing segment of the Des Moines bicycle trail which traverses the project site will be incorporated into the design of the plaza. The borrow site which will be used to obtain fill material (see Plate 1) has been and is currently used by the City of Des Moines as a borrow source for other projects. The effects of borrow activities on this area were previously addressed in the Final Supplement No. 1 to the Final Environmental Impact Statement (FEIS) for the General Reevaluation Report for the Local Flood Control Project on Raccoon River and Walnut Creek, West Des Moines and Des Moines, Iowa (July 1989). The disposal sites are currently being used for disposal for other City projects and no adverse impacts are anticipated to result from their use for this project.

(2) The long-term effect of the project is expected to be beneficial to man-made resources in the area with no adverse effect on natural resources. No mining activity is present in the project area and no mineral resources will be affected by the proposed action. No long-term adverse impacts to water quality are anticipated. A Section 404(b)(1) Evaluation has been prepared to address the placement of construction materials for the stage structure in the Des Moines River (see Appendix B). Section 401 certification has been received from the State of Iowa by letter dated April 30, 1992 (see Appendix A). Minor, temporary impacts to air quality may occur as a result of construction and transportation of materials. No long-term significant impacts are anticipated and no air quality standards should be violated.

(3) The only Federally listed threatened or endangered species listed for the project area is the bald eagle (Haliaeetus leucocephalus). Bald eagles utilize large trees along larger rivers and streams as resting and feeding perches during winter months. There is currently no known use of the project area by eagles or by any other Federally endangered species. There is no designated critical habitat

in the project area at this time and no habitat suitable for Federal or State listed species will be altered by the proposed work. For these reasons, no impacts to endangered species are anticipated.

(4) A contract for an archaeological survey was awarded to American Resources Group, LTD. of Carbondale, Illinois and documented in the report Phase II Archaeological and Geomorphological Investigations at the Proposed Greenbelt Project, Des Moines, Iowa which adhered to the minimum qualifications for field work, reporting, and curation standards as described in the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (1984).

(a) As designed the project will extend into the National Register of Historic Places Civic Center Historic District. The proposed construction includes a low profile design, metal arc mast for lighting and sound attachment, and stage which penetrates the river wall and extends into the river channel. This action is sympathetic to the river wall, a contributing structure within the Historic District.

(b) Borrow material will be obtained from a City owned borrow site previously used for the reconstruction and recondition of the city of Des Moines Levee segment from SE. Sixth to SE. 14th Streets. This borrow site is near the intersection of Hartford Avenue and 22nd Street Southeast and was previously determined by the SHPO to contain no historic properties. Soil and fill material placement will be placed within one of two historic landfills owned by the Landfill of Des Moines, Inc. These privately owned landfills are located on 1801 West Euclid and 1805 Southeast Hartford Street in Des Moines and have been previously disturbed and determined to contain no historic properties.

(c) Based on the results of these investigations, the Corps and the City documented a finding of **No Adverse Effect** for the proposed Downtown Riverfront Plaza/Amphitheater, applying the Criteria of Effect (36 CFR Part 800.9) required by Section 106 of the National Historic Preservation Act (NHPA), as amended.

g. Social Impact Assessment

(1) Community and Regional Growth

No significant impacts to community or regional growth would result from construction of the proposed riverfront plaza and amphitheater.

(2) Displacement of People

The proposed project would not require residential relocations.

(3) Farm Displacement

No farms would be affected by the proposed project.

(4) Community Cohesion

The addition of new recreational/leisure facilities would positively impact community cohesion. The plaza and amphitheater allows for interaction among local residents, workers, and shoppers, and allows for interaction with those visiting from neighboring communities. Similar projects in other communities have created important focal points for workers to meet for lunch and socializing as well as for residents to have similar experiences on weekends and in the evening.

(5) Public Facilities and Services

The project will definitely enhance opportunities for recreation within the Des Moines Metropolitan Area. The amphitheater will be the site for many concerts, theatrical performances, and festivals. It will provide downtown workers with a pleasant location for walking and eating during lunchtime, and it will provide a convenient resting area for those using the East River Bike Trail. The plaza and amphitheater will be the only major public space designed as a gathering point on the east bank of the Des Moines River.

(6) Life, Health, and Safety

The proposed development would not have any negative effects on the life, health, or safety of the users. The developments will offer opportunities for people to pursue recreational/leisure activities closer to home. The project design allows easy access by handicapped individuals, and handicapped parking will adjoin the site.

(7) Property Values and Tax Revenues

The potential value of property in the project vicinity could increase as a result of the plaza and amphitheater construction. Long term effects on property values and tax revenues would be related to community and regional growth resulting from the proposed project.

(8) Business and Industrial Growth

Construction of the project would slightly increase business and industrial activity related to construction supplies. Some growth in downtown business activity could be generated by the increased numbers of visitors to the site. No business relocations would be necessitated by the proposed new facilities.

(9) Employment and Labor Force

The proposed construction would slightly impact short-term employment in the Des Moines SMA. The City of Des Moines has a large enough labor pool to absorb project needs with no noticeable impact. No direct long-term impacts on employment in the Des Moines SMA would be realized from the project.

(10) Noise Levels

Heavy machinery would generate temporary increases in noise levels during construction. Also, adding riverfront activities could increase noise levels. This increase has the potential to disturb visitors or persons working in the riverfront business district. Local ordinances are expected to control excess noise that might be project induced.

(11) Aesthetic Values

The results of the proposed project should improve aesthetic values. The tree lined plaza with well groomed terraced area will offer views of the river and river activities. The site will give users an impressive view of the downtown skyline and evening lights.

h. Coordination

(1) The proposed action has been coordinated with the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the Iowa Department of Natural Resources (IDNR), and the State Historic Preservation Officer (SHPO). On April 6, 1992, the IDNR issued a Sovereign Lands Construction permit to the City of Des Moines for the project. Copies of coordination letters are contained in Appendix A.

(2) On July 15, 1991, the SHPO stated that they were willing to issue a finding of **No Adverse Effect**, subject to conditions. Pursuant to the effects of the project on the National Register of Historic Places listed Historic District promulgated by 36 CFR Part 800.5, the Corps will comply with the SHPO conditions which are as follows:

(a) The Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings will be cited in all construction and bid documents.

(b) Final architectural plans and specifications for this project will be submitted to the Review and Compliance Section of the Bureau of Historic Preservation for review and approval prior to commencement of the project.

(3) On September 4, 1991, the Corps and the City received agreement from the Advisory Council on Historic Preservation (ACHP) that the documentation outlined in 36 CFR Section 800.8(a) and 800.9(c)(2), as promulgated by the conditions of the SHPO under 36 CFR Part 800.5(d)(2) of the NHPA, demonstrated that the project would not adversely affect the Civic Center Historic District, a property listed on the National Register of Historic Places. The ACHP also stated that the Corps and the City met the requirements of the NHPA for this project.

4. DESIGN AND CONSTRUCTION CONSIDERATIONS

a. General Considerations

(1) The project site was selected by the City of Des Moines and the amphitheater is part of their Riverfront Master Plan and the Vision 2000 Plan for the City of Des Moines. The conceptual design for the project was done by the Architectural Firm of Herbert Lewis Kruse Blunck (HLKB) of Des Moines acting as a consultant for the project sponsor and proponents. Preparation of plans and specifications will be done by the Corps of Engineers and coordinated with the City of Des Moines and HLKB.

(2) A design which is sympathetic to the Des Moines Riverwall characteristics and setting within the National Register of Historic Places Civic Center Historic District is required by 36 CFR Part 800 and the Secretary of Interior's Standards for Rehabilitation. Plate 1 shows the boundary of the Civic Center Historic District.

(3) The design must maintain the line-of-protection afforded by the existing levee which is part of the Des Moines LFPP. Elevation 803.8, the design levee grade, must be maintained and Gatewell "D" must remain intact and operational. Plate 5 shows the As-Built LFPP in the project area.

b. Design References

A list of basic data and criteria used in the design is found in Table 2-1.

c. Hydrology and Hydraulics

River stage hydrographs were developed for the Des Moines River (see Plates 2 and 3). The ordinary high water elevation is approximately 780.5 at the project site which is approximately one foot above the existing riverwalk. All new construction landward of the riverwall will be at approximate elevation 788.0 or higher. As shown on Plate 2, the duration of elevation 788.0 is less than 3 percent. The stage elevation varies between 788.9 -790.3, a duration of 1 percent or less. Extensive hydraulic analyses were performed to determine the impacts of the proposed project (see Appendix E). The analyses showed that assuming construction of the amphitheater, the level of protection of the LFPP is maintained as originally designed.

TABLE 2-1

DESIGN REFERENCES

1. EC 1110-2-268, Engineering and Design for Civil Works Projects, 1 July 1991.

2. EM 1110-2-1913, Design and Construction of Levees, 31 March 1978.

3. City of Des Moines Standard Specifications for Construction of Public Improvements, August 1984.

4. As-Built Construction Drawings, Des Moines Flood Control Project, Drawing No. DM-1, Stage 1 (Reach 3), 5 January 1972.

5. Water Service System Maps, Construction Notes, and Flow Test, Des Moines Water Works, 20 March 1991.

6. EM 1110-2-2906, Design of Pile Foundations, 15 January 1991.

7. EM 1110-2-2502, Retaining and Flood Walls, 29 September 1989.

8. ETL 1110-2-312, Strength Design for Reinforced Concrete Hydraulic Structures, 10 March 1988.

9. ACI 318-89, Building Code Requirements for Reinforced Concrete.

10. ASCE 7-88, Minimum Loads for Buildings and Other Structures, July 1990.

11. Aluminum Construction Manual - Specifications for Aluminum Structures and Engineering Data for Aluminum Structures, January 1975.

12. EM 1110-2-1612, Ice Engineering, 15 October 1982.

d. Geotechnical

Appendix C contains the results of geotechnical explorations which were conducted in January 1991 to conduct soil sampling, rock coring, and concrete coring in support of the subject project. Boring logs are included in Appendix C and on Plate 4. Information from a previous boring (DM-6, 8 Oct 64) which was done in support of the LFPP is also included on Plate 4. The structural design for the project has been based on the geotechnical information obtained.

e. LFPP/Line-of-Protection (LOP) Considerations

Plates 5 and 6 show the As-Built LFPP and existing site conditions respectively. The LOP through the project site currently consists of a grass-covered earth levee, design grade elevation 803.8, between Locust Street to the north and Walnut Street to the south. Across Locust Street, the LOP ties into a floodwall adjacent to City Hall and across Walnut Street, the LOP ties into the continuation of the levee. The subject project proposes to replace the freeboard portion of the existing levee with a reinforced concrete floodwall/planter box maintaining the design levee grade of 803.8. Two openings in the floodwall/planter will be constructed with removable stop logs to close these six-foot wide openings between elevation 801.0 and 803.8 (see Plates 9 and 17).

f. Demolition

Plate 8 shows the Demolition Plan and Details. Existing sidewalk will be removed to accommodate new construction. Parking meters and barrier posts will be salvaged and transferred to the City of Des Moines. Two sections of the riverwall and the existing stairs down to the riverwalk will be removed to the extent required for construction. Care will be exercised so as not to damage the remainder of the riverwall or the interceptor sewer.

g. Architectural Considerations

The plaza/amphitheater plan, elevation and section views are shown on Plates 9 and 10. The design includes the required provisions for the physically disabled. Stairs, sloped walks, and a stair-lift provide access from the plaza level at the top of the amphitheater to the stage at the lower level of the amphitheater. The design has been, and will continue to be, coordinated closely with the Iowa State Historic Preservation Office to assure that all requirements of the National Historic Preservation Act are met.

h. Structural

Appendix D and Plates 11-18 address Structural considerations in detail.

i. Drainage and Water/Irrigation

Appendix E, paragraph 4, addresses drainage along with Plate 19. Water for irrigation and the two drinking fountains will be supplied from an existing 12" water line. Fire protection will be provided from existing hydrants along Locust and Walnut Streets. The project does not include any facilities which will require connection to a sanitary sewer.

j. Site Lighting and Power

(1) The service is to be supplied by Iowa Power and terminated on a 400 Ampere disconnect located in the electrical termination box (see Plates 20 and 21). The 400 Ampere disconnect shall be fused with 3-300 amp fuses. In the electrical termination box, the service will be metered using current transformers according to Iowa Power's standards. The service will then be split into two separate feeders. One feeder will feed a 45 kVA isolation transformer which feeds a 100 Ampere disconnect located on the stage. This will provide an isolated circuit to power audio equipment. The other feeder will feed a 225 Ampere, 42-circuit panel (P1). Panel P1 will feed all receptacles, junction boxes, and lights.

(2) The lights (F1) will be part of an overall City of Des Moines Riverfront Lighting Master Plan, 208 volt, and controlled by a remote-controlled breaker. The remote-controlled breaker is operated by a photoelectric cell mounted on top of the arch. The remote controlled-breaker requires a 24 volt DC supply which is located in panel P1.

(3) The receptacles (20A) will be ground fault interrupting (G.F.I.) and the covers will be approved for wet locations while in use. The receptacles on the Plaza and in the planter box shall be mounted as shown in the receptacle detail (Plate 20). The receptacles mounted in the stairs on the stage shall be flush mounted for use in concrete. The receptacles on the arch supports will be mounted in the yoke of the I-beam and will be surface mounted. The arch will be fabricated with flattened areas to accommodate three junction boxes and 20 receptacles (20A), (see Plate 22).

(4) The two junction boxes in the planter will be flush-mounted. The conductors will not be permanently terminated on either end, but can be terminated as needed. An empty 18" reinforced concrete pipe (RCP) is provided to allow the user a means of routing lighting and control wires between a manhole located on the stage and a handhole located near panel P1.

5. REAL ESTATE REQUIREMENTS

a. Local Cooperation Agreement/Cost-Sharing

The City of Des Moines has provided a letter of assurance dated October 17, 1989 indicating its willingness to act as the sponsor for the project (see Appendix A). In compliance with the requirements of P.L. 91-611, the City must enter into a Local Cooperation Agreement with the Government prior to construction of the project. A draft Local Cooperation Agreement is not contained in this report, but is being coordinated with the City. The City will be required to comply with the provisions of P.L. 99-662, 91-646, as amended, and any other applicable laws. In general, the City will be required to pay 50% of the total project costs; furnish all rights-of-way necessary for the project; relocate or modify all utilities and other facilities; hold the Government harmless from all damages; and operate and maintain the project without cost to the Government in accordance with Government regulations.

b. General

The Downtown Riverfront Plaza/Amphitheater as proposed in this report involves approximately 1 acre and all project features are located on land owned by the City of Des Moines. A borrow area (see Plate 1), which is owned by the City of Des Moines, will be utilized in conjunction with another project known as the Des Moines River - Levee Design Deficiency. Two approved commercial disposal sites are located near the project (see Plate 1), and as such, the contractor will be required to utilize these sites.

c. Relocations

Relocation of a utility gas line owned by Midwest Gas Company will need to be accomplished by the local sponsor. No credit for the relocation will be allowed, as the sponsor has the authority to require the relocation at no cost to the sponsor.

d. Credits

Credit for sponsor-owned lands shall be based on the fair market value of the interest required for the project and should be appraised using Federal rules of compensation in estimating the fair market value. An appraisal of the property in its "before" and "after" condition will be needed. The property, probably, in its "after" condition will be worth more since it will have been improved with the Plaza/Amphitheater. It could be assumed that the appraisal will therefore result in no credit being assigned for the real estate interests required and such values are not included in the total project costs.

6. OPERATIONS AND MAINTENANCE CONSIDERATIONS

a. Operation

The project will be operated by the City of Des Moines.

b. Maintenance

The project maintenance will be done by the City of Des Moines.

c. Operation and Maintenance Manual

An operation and maintenance manual will be prepared during construction and coordinated with the local sponsor and the Corps of Engineers, North Central Division, prior to publishing a final manual at the time of project turnover (approximately June 1994). Information on all installed items and As-Built Construction Drawings will also be prepared and turned over to the local sponsor.

d. Annual Joint Inspection

An annual joint inspection by the local sponsor's Site Manager and the Corps of Engineers will be scheduled by the Corps in accordance with ER 1165-2-131. The purpose of this inspection is to assure that adequate maintenance is being performed as required by the LCA and operation and maintenance manual. The District Engineer or Authorized Representatives should have access to all portions of the constructed project upon coordination with the Site Manager for this purpose. Copies of this inspection will be furnished to the Site Manager stating project maintenance conditions. Corrective actions from these inspections should be accomplished by the Site Manager as provided by the LCA.

7. COST ESTIMATE.

a. General

This section contains the detailed cost estimate which was prepared for the Downtown Riverfront Plaza/-Amphitheater, Des Moines, IA, including lands and damages, construction, planning, engineering and design and construction management costs. The current working estimate (CWE) prepared for this Feature Design Memorandum (FDM) was developed after review of project plans, discussion with the design team members, and review of costs for similar construction projects. The Micro-Computer Aided Cost Estimating System (M-CACES Gold, v. 5.01D), incorporating local wage and equipment rates, was utilized to assemble and calculate project element costs. These costs, including appropriate contingencies, are presented in accordance with EC 1110-2-536, Civil Works Project Cost Estimating - Code of Accounts.

b. Price Level

Project element costs are based on June 1992 prices. These costs are considered fair and reasonable to a well-equipped and capable contractor and include overhead and profit. Calculation of the Fully Funded Estimate (FFE) was done in accordance with guidance from CECW-B Memorandum, dated 7 Feb 92, Subject: Factors for Updating Study/Project Cost Estimates for the FY 1994 Budget Submission. Table 7-1 shows the Project Cost Summary outlining the Federal and Non-Federal share for both the CWE and FFE. Table 7-2 is the construction cost estimate.

c. Contingency Discussion

After review of project documents and discussion with personnel involved in the project, cost contingencies were assigned which reflect the uncertainty associated with each cost item. Per EC 1110-2-263, these contingencies are based on qualified cost engineering judgement of the available design data, type of work involved, and uncertainties associated with the work and schedule. Costs were not added to contingency amounts to cover items which are identified project requirements. The following discussion of major project features indicates the basis for contingency selection and assumptions made. For other elements not addressed below, the assignment of contingencies was deemed appropriate to account for the uncertainty in design and quantity calculation and further discussion is not included.

TABLE 7 - 1

PROJECT COST SUMMARY

DIVISION OF COST

JUNE 1992

ACCOUNT	FEATURE		CURRENT WORKING ESTIMATE 3/ (CWE)		FULLY FUNDED 1/ ESTIMATE (FFE)	
			FEDERAL	NON-FEDERAL	FEDERAL	NON-FEDERAL
01.	LANDS AND DAMAGES 2/		$2,500	$2,500	2,500	$2,500
14.	RECREATION FACILITIES		626,500	626,500	664,800	664,800
30.	PLANNING, ENGRING & DSGN		117,500	117,500	119,600	119,600
	FEATURE DSGN MEMO	175,000				
	PLANS & SPECS	55,000				
	E & D DURING CONSTR	5,000				
31.	CONSTRUCTION MANAGEMENT		70,000	70,000	73,500	73,500
	CONTRCT ADMIN	61,000				
	SHOP DWG REVIEW	11,200				
	INSPCT/QUALITY ASSURNCE	67,200				
	SUBTOTAL		816,500	816,500	860,400	860,400
	COMBINED TOTAL PROJECT COST		$1,633,000		$1,720,800	

NOTES:

1/ CONSTRUCTION SCHEDULED FOR JUNE 93 - JUNE 94. FULLY FUNDED ESTIMATE (FFE) IS CALCULATED PER CECW-B MEMORANDUM, 7 FEB 92, SUBJECT: FACTORS FOR THE FY 1994 BUDGET SUBMISSION.

2/ NO INFLATION MADE TO A LANDS AND DAMAGES ACCOUNT FOR FFE.

3/ M-CACES ESTIMATE COMPLETED JUNE 1992. UPDATED AUGUST 1992.

TABLE 7-2

		QUANTY	UOM	CONTRACT	CONTINCY	TOTAL COST	UNIT
I	Riverfront Plaza/Amphitheater						
I/14	RECREATION FACILITIES						
I/14.0	Recreation Facilities						
I/14.0.2	Site Grading and Landscaping						
I/14.0.2.B	Sitework						
I/14.0.2.B 01	Clearing			10,457	3,137	13,594	
I/14.0.2.B 02	Excavation & Stockpile	604.00	CY	1,649	165	1,814	3.00
I/14.0.2.B 03	Excavation & Haul Away	2880.00	CY	17,064	1,706	18,770	6.52
I/14.0.2.B 04	Embankment	604.00	CY	3,308	662	3,970	6.57
I/14.0.2.B 05	Place Topsoil	532.00	CY	15,442	1,544	16,986	31.93
I/14.0.2.B 06	Plaza Ash Trees	18.00	EA	11,935	1,193	13,128	729.34
I/14.0.2.B 07	Amphitheater Pine Trees	27.00	EA	12,749	1,275	14,024	519.39
I/14.0.2.B 08	Sodding	2640.00	SY	9,791	979	10,770	4.08
I/14.0.2.B 09	Seeding	2000.00	SF	126	13	139	0.07
I/14.0.2.B 10	Metal Tree Grates	45.00	EA	22,860	2,286	25,146	558.81
I/14.0.2.B 11	Brick Pavers	11300	SF	128,614	12,861	141,476	12.52
I/14.0.2.B 12	Checkerblock	2000.00	SF	13,235	1,324	14,559	7.28
	Sitework			247,230	27,145	274,375	
I/14.0.2.Q	Mechanical						
I/14.0.2.Q 01	Irrigation System			17,295	1,730	19,025	
I/14.0.2.Q 02	Water Hydrant System			2,935	587	3,522	
I/14.0.2.Q 03	Drinking Fountains	2.00	EA	3,687	369	4,056	2027.92
	Mechanical			23,917	2,685	26,603	
	Site Grading and Landscaping			271,147	29,830	300,978	
I/14.0.4	Day Use Areas						
I/14.0.4.B	Sitework						
I/14.0.4.B 01	Sidewalk, 6"	1222.00	SF	3,380	338	3,718	3.04
I/14.0.4.B 02	Sidewalk, 4"	10067	SF	24,326	6,081	30,407	3.02
	Sitework			27,706	6,419	34,126	
I/14.0.4.C	Concrete						
I/14.0.4.C 01	Concrete Elevated Slab	203.00	CY	63,225	12,645	75,870	373.74

LABOR ID: AMPTRI EQUIP ID: RG591A Currency in DOLLARS CREW ID: RG591A UPB ID: RG591A

		QUANTY UOM	CONTRACT	CONTINCY	TOTAL COST	UNIT
I/14.0.4.C 02	Concrete Stairways		19,653	1,965	21,618	
I/14.0.4.C 03	Concrete Wall	190.00 CY	48,685	9,737	58,422	307.48
I/14.0.4.C 04	Concrete Pile Caps (2 EA)	18.00 CY	2,861	286	3,147	174.83
I/14.0.4.C 05	Concrete Floodwall Planter Box	366.00 CY	87,506	17,501	105,008	286.91
	Concrete		221,930	42,135	264,064	
I/14.0.4.S	Structural					
I/14.0.4.S 01	Mob/Set Up For Pile Driving		21,109	3,166	24,275	
I/14.0.4.S 02	Steel Sheet Piling	1020.00 SF	19,532	2,930	22,462	22.02
I/14.0.4.S 04	Steel Pipe Piling	1700.00 VLF	42,717	8,543	51,261	30.15
I/14.0.4.S 05	Structural Aluminum Arch		135,406	13,541	148,946	
I/14.0.4.S 06	Backfill for Sheetpiling	414.00 CY	8,523	852	9,375	22.65
	Structural		227,287	29,032	256,319	
	Day Use Areas		476,923	77,586	554,509	
I/14.0.6	Utilities					
I/14.0.6.B	Sitework					
I/14.0.6.B 01	Site Drainage		9,666	967	10,632	
I/14.0.6.B 02	Site Lighting and Power		190,403	38,081	228,484	
	Sitework		200,069	39,047	239,116	
	Utilities		200,069	39,047	239,116	
I/14.0.A	Mob. Demob. & Preparatory Work					
I/14.0.A.-	Preparatory Work					
I/14.0.A.- 01	Mobilization & Demobilization		26,502	2,650	29,152	
	Preparatory Work		26,502	2,650	29,152	
	Mob. Demob. & Preparatory Work		26,502	2,650	29,152	
I/14.0.R	Associated General Items					
I/14.0.R.B	Sitework					
I/14.0.R.B 01	Trash Receptacles	8.00 EA	5,134	513	5,648	705.97
I/14.0.R.B 02	Circular Seating	11.00 EA	78,398	7,840	86,238	7839.83
I/14.0.R.B 03	Handicapped Chair Lift	1.00 EA	30,948	6,190	37,138	37138

TABLE 7-2 cont'd

	QUANTY UOM	CONTRACT	CONTINCY	TOTAL COST	UNIT
Sitework		114,481	14,543	129,023	
Associated General Items		114,481	14,543	129,023	
Recreation Facilities		1,089,121	163,657	1,252,778	
RECREATION FACILITIES		1,089,121	163,657	1,252,778	
1/30 PLANNING, ENGINEERING & DESIGN (See Table 7-1)					
1/31 CONSTRUCTION MANAGEMENT (See Table 7-1)					
Riverfront Plaza/Amphitheater		1,089,121	163,657	1,252,778	
Downtown Riverfront Plaza/	1.00 EA	1,089,121	163,657	1,252,778	1252778

(1) 14.0.2.B 01 Clearing. The quantities for this work were developed by Design Branch and Cost Engineering Branch. This item includes demolition of the existing sidewalk, stairs, and a portion of the riverwall as shown on Plate 8. There is some uncertainty concerning the riverwall construction because the existing riverwall is a combination of a wall which was built around 1900 and revised by a project in 1933 and 1934. As-Built information is sketchy at best.

(2) 14.0.4.B 02 Sidewalk, 4". The quantities for this work were developed by Cost Engineering Branch. The curved walks from the plaza to the stage are presently planned as four inches thick, however these may be thickened to six inches to accommodate delivery trucks which might use the sidewalk as an access road to the stage. This will be analyzed further prior to proceeding to Plans and Specifications.

(3) 14.0.4.S Structural. The quantities for this group of items were developed by Design Branch and Cost Engineering Branch. Borings were taken and pile lengths based on the information obtained, however no borings were taken in the river where all of the sheet piling will be placed and some of the pipe piling will be placed. Glacial erosional channels cannot be ruled out and the elevation of the top of rock may be lower than indicated by the three borings which were taken. Also, there might be delays or damage to construction work caused by high flows as experienced during the spring and summer of 1991. Refer to the discussion of Geotechnical Considerations in Appendix C.

8. ECONOMIC ANALYSIS

a. Introduction

(1) This analysis examines the economic feasibility of constructing a Riverfront Plaza and Amphitheater on the east bank of the Des Moines River in downtown Des Moines, Iowa. The proposed Plaza and Amphitheater would enhance the recreation experience afforded to the residents of the Des Moines Metropolitan Area and help fulfill current and future demand for recreational facilities in central Iowa.

(2) The City of Des Moines is located in the central portion of Iowa in Polk County, approximately 25 miles southeast of Saylorville Reservoir. As the site of the state capital, the Des Moines greater metropolitan area has experienced steady population growth during the past four decades. The Des Moines Metropolitan Statistical Area (MSA) consists of the following counties: Dallas, Polk and Warren. Population growth trends for this MSA are shown in Table 8-1.

Table 8-1
Population Trends - Des Moines MSA

County	1960	1970	1980	1990
Dallas	24,123	26,085	29,513	29,755
Polk	266,315	286,130	303,170	327,140
Warren	20,829	27,432	34,878	36,033
MSA Total	311,267	339,647	367,561	392,928

Source: United States Bureau of the Census.

(3) Although the metropolitan area showed consistant growth, as with other metropolitan areas, the decades from 1960 to 1980 did reflect a decrease in the City of Des Moines population. There has been a slight reversal of this trend as the 1990 census reflects an increase in population of more than 2,000 residents over the 1980 population.

(4) Table 8-2 shows this increase for the City of Des Moines and the population growth trend for communities within a thirty minute drive of the proposed site. It is this population which will be most likely to attend evening and weekend functions scheduled for the proposed Riverfront Plaza and Amphitheater. Noon hour events will draw their

largest audiences from employees working in the many private and public office buildings within a three to four block walk of the site.

Table 8-2
Population Trend - Communities

	1960	1970	1980	1990
Ackworth	77	111	83	66
Adel	2,060	2,419	3,846	3,304
Alleman	-	-	307	340
Altoona	1,458	2,854	5,764	7,191
Ankeny	2,964	9,151	15,429	18,482
Bevington	55	54	60	67
Bondurant	389	462	1,283	1,584
Carlisle	1,317	2,246	3,070	3,241
Clive	752	3,005	6,064	7,462
Cumming	148	189	151	132
Dallas Center	1,083	1,128	1,360	1,454
De Sota	273	369	1,035	1,033
Des Moines	208,982	200,587	191,003	193,187
Elkhart	260	269	256	388
Granger	468	661	619	624
Greenfield	2,243	2,221	2,243	2,074
Grimes	697	834	1,973	2,653
Hartford	271	582	761	768
Indianola	7,062	8,852	10,843	11,340
Johnston	-	222	2,526	4,702
Martinsdale	316	306	438	491
Mitchelville	957	1,341	1,530	1,670
Norwalk	1,328	1,745	2,676	5,726
Pleasant Hill	397	1,535	3,493	3,671
Polk City	567	715	1,658	1,908
Runnells	322	354	377	306
Sandyville	115	89	86	59
Saylorville	-	-	-	2,709
Spring Hill	111	131	95	86
Swan	168	56	102	76
Urbandale	5,821	14,434	17,869	23,500
Waukee	687	1,577	2,227	2,512
West Des Moines	11,949	16,441	21,894	31,702
Windsor Heights	4,715	6,303	5,474	5,190
Totals	258,012	281,234	306,595	339,698

Source: United States Bureau of the Census.

b. Existing Conditions

(1) Downtown Des Moines does not have a major public space designed as a gathering point on the east bank of the Des Moines River that provides both a view of and access to the river. Some functions are held on the lawn in front of the Iowa State Capitol Building, but the sidewalks leading to the area are steep and not easily traveled by the physically impaired. At present the city has no outdoor amphitheater. Outdoor concerts are held in the community parks, where a stage is set up about 2-feet above ground level, with the attendees looking up at the performers. There are no graduated seating areas and no formal lighting systems.

(2) The 5.5 mile long East River Bike Trail, running along the Des Moines River, begins at Hawthorn Park, proceeds through the proposed Riverfront Plaza/Amphitheater site, meets the Saylorville/Des Moines Bike Trail at Birdland Park, and ends at McHenry Park (See Figure 8-1). Comprised of both Federal and non-Federal trail segments, the Saylorville/Des Moines Multi-purpose Trail is over 28 miles in length. Generally following the course of the Des Moines River, it crosses Federal, county and city property, passing through various parks and public developments, and links the metropolitan area to recreation facilities at Saylorville Reservoir.

(3) The existing East River Bike Trail section at the proposed site is actually a city sidewalk that parallels the levee, giving cyclists and other users a view of a hotel wall and a very restricted view of the riverfront. Any sizeable recreationist gathering at the proposed site entails sprawling on the land- or riverward side of the levee, or attempting to crowd into the sidewalk area between the exterior wall of a hotel and the levee. There are no public drinking fountains between Hawthorne Park and Birdland Park (Figure 8-1).

(4) The proposed Riverfront Plaza and Amphitheater would include 64,768 square feet, have a stage that projects over the river, a sloped grassed seating area, drinking fountains, and a tree shaded, landscaped plaza. Handicapped accessibility will be provided by a lift. A sloping pathway will facilate access to the seating and stage areas.

(5) Without the project, picnickers may either sit on top of, or on the severe slope of, the existing levee and the sloped riverbank. The vegetation is mowed, but it is not a groomed, grassed area conducive to sitting upon. The site has one tree. There is one picnic table across the street. There are no public outdoor drinking fountains in the area. A view of the river could only be obtained from

DES MOINES BICYCLE TRAIL SYSTEM

Bike Routes on designated City Streets

Existing Bike Trails

Proposed Bike Trails

Existing Bike Trail Staging Areas:

1. McHenry Park
2. Birdland Marina
3. East 1st and Grand
4. Hawthorn Park
5. Ashworth Pool Parking Lot

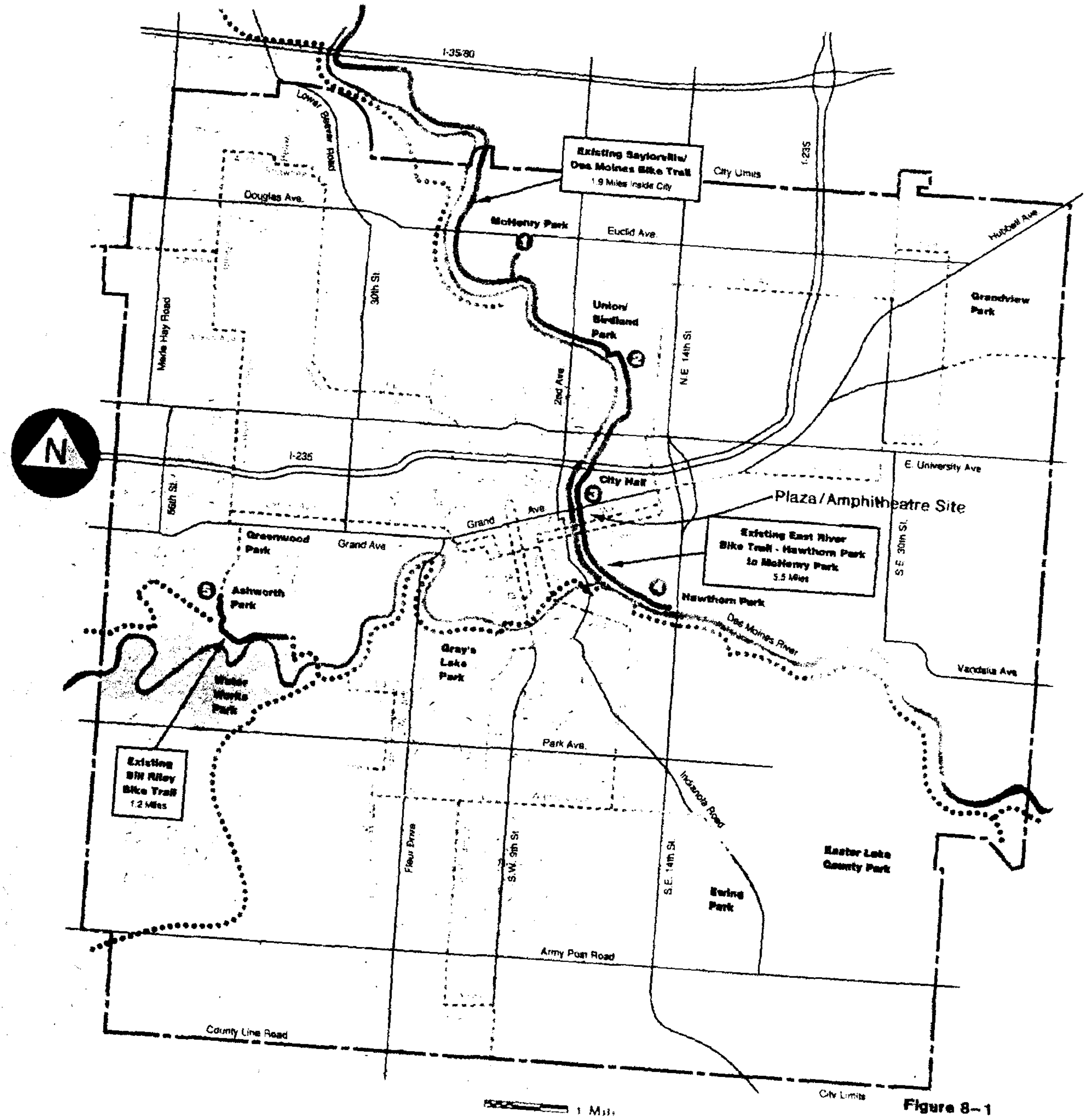

Figure 8-1

sitting on the steep side of the riverbank or on the top of the levee. Sitting on the landward side of the levee for lunch, users have a view of the exterior wall of a hotel or of the levee. If used on a daily basis by picnickers, the steep sided levee and riverbank would experience deterioration of the existing resource. During drought conditions, the riverbank experiences rutting from heavy rain events. It is virtually impossible for the handicapped to access the area.

(6) The Riverfront Amphitheater and Plaza would create a unique recreational feature for the downtown area east of the Des Moines River. It will provide a casual atmosphere for picnic lunches, relaxing, and informal gatherings and entertaiment, and also will create a more aesthetically appealing byway for walkers, cyclists and all users. Users in the terraced seating area will have a very aesthetically appealing view of the downtown skyline. Users, who are sitting in the lower levels, will see pebble sided bridges flanking a view of the grassed and tree lined slope in front of the downtown Public Library directly across the river.

c. Recreational Opportunities

(1) In addition to concerts and theatrical performances in the amphitheater, the proposed Plaza will join other locales as a site for festival events, such as the Two Rivers Festival, the Carp Festival, fireworks display viewing, etc. With the Plaza situated on a city bike trail, it may also be used as the start and/or finish point for many running, walking, and bicycling events. The proposed Plaza will enhance recreation opportunities for all users within the Des Moines Recreational River and Greenbelt boundaries.

(2) In general, the expected users are: attendees at various major Festivals attractions, jazz and chamber music concerts, Shakespearean and other performances, and presentations by public and private groups; walkers, joggers and cyclists. From a daily use perspective, the largest single group of users is expected to be noon hour "brown baggers".

d. Benefit Computation

(1) Figure 6.7 of the Guidelines for Conducting Civil Works Planning Studies (ER 1105-2-100) gives the criteria used to select the procedure for evaluating recreation projects. The steps indicated in the Guidelines are shown in Table 8-3 and result in the Unit Day Value Method being used to determine the benefits for this project.

Table 8-3
Criteria for Selecting an Appropriate Procedure

Criteria	Answer
Is a regional model available?	No
If "No", do uses affected involve specialized recreation activities?	No
If "No", do expected recreation costs exceed 25-percent of expended total project costs?	Yes
If "Yes", do specific annual Federal recreation costs exceed $1,750,000 FY 91 ($1,000,000 FY82)?	No

If "No", then use Unit Day Values for evaluating recreation benefits resulting from the proposed project.

(2) The Guidelines selection criteria allow consideration to be given to the size of the recreation benefit created and the nature of the activities affected. Selection of a specific evaluation procedure is also based on the relative importance of any specialized recreation activity, the advantages of the respective methods, and cost considerations. Following the above criteria and considering the small scale of the proposed project, the Unit Day Value Method is the preferred evaluation procedure for this analysis. Using ER 1105-2-100, Guidelines for Assigning Points for General Recreation, Table 6-29, points were determined for the three categories of usage for the plaza site in a without project condition. Unit Day Values were then computed. All unit day values were based upon ER 1105-2-100, with the Revised Table 6-28 (FY91).

(3) Judgment factor points are determined for both the existing "without project" and the proposed "with project" conditions. Because of the varied nature of the activities possible at the Riverfront Plaza and Amphitheater site, computation of Unit Day Values (UDV) were determined for picnicking; general amphitheatre recreational activities including concerts, festival events, other artistic performances, presentations; and trail use. The UDV increases were based upon the comparison of (a) having an activity or event at the site in its existing condition and the improvement based upon the "with project" condition (e.g. picnicking); (b) having a new event at the Amphitheater site in the "without" and "with" condition, (c) having an event relocated to the Amphitheater site, and (d) the "without" and "with" project condition of this portion of the existing East River Bike Trail.

(4) Table 8-4 presents a summary of the Unit Day Value Method assessment for recreation experience by picnickers. As stated previously, the largest daily use is expected to be by noon hour "brown baggers".

Table 8-4
Unit Day Value Assessment for Picnickers

Criteria	Judgment Factor Points Without Proj	With Proj	Comments
Recreation Experience	2.0	10.0	Plaza would have a wider area for multiple use at one time, and provide a groomed grassed area for use by picnickers and other users. The sloped pathway will provide users with easy access to the varied seating levels.
Availability of Opportunity	2.0	8.0	Landscaped area with shade trees, terraced groomed area, drinking fountains. New plaza would provide a unique opportunity for users to enjoy various events during their use of this area.
Carrying Capacity	1.0	6.5	New plaza and groomed terraced seating trail will allow the use of the site without deterioration of the resource.
Accessibility	6.0	15.0	Exceptionally easy access to the site from downtown streets and major expressway. Handicapped ramps will allow ready access to the site from handicapped parking which adjoins the site. Gentle slopes will allow easy access within the site. A lift will permit easy access for the handicapped.
Environmental	1.5	9.5	The garden plaza site will create a tree lined plaza with a view of the river, and an impressive view of the downtown Des Moines skyline.

Total Points:	Without Project	12.5	With Project	49.0
Point Value		$2.70		$4.70

Net increase in value per Picnicker = $2.00

(5) Table 8-5 presents a summary of the Unit Day Value Method Assessment for general amphitheater recreation experience users. In this instance, the users would be attending concerts, artistic performances, presentations and workshops from public or private organizations, and similar events.

Table 8-5
Unit Day Value Assessment for An Amphitheater

Criteria	Judgment Factor Points Without Proj	With Proj	Comments
Recreation Experience	2.0	10.5	Amphitheater will permit a broader use of site. The stage will provide a formal focal point for concerts, artistic performances, workshops, and speakers. Terraced groomed circular seating area will enhance user's enjoyment of events and provide excellent viewing of the stage.
Availability of Opportunity	1.0	11.0	The City of Des Moines has no other outdoor amphitheater.
Carrying Capacity	1.0	8.9	Amphitheater and Riverfront Plaza will be very adequate for the proposed uses. The gentle slope of the terraced seating area and the pathway leading to the stage area will abet resource continuation.
Accessi-bility	6.0	15.0	Good access to the site from major expressways and downtown streets. Handicapped parking adjoins the site with handicapped access ramps. The sloped pathways and a lift will facilitate access to the seating and stage area.

Environ-mental	1.0	9.5	The tree lined plaza with well groomed terraced area offers views of the river and river activities. Site will give users an impressive view of the downtown skyline and evening lights.

Total Points: Without Project 11 With Project 54.9
Point Value $2.64 $4.97

Net increase in value per Amphitheater User = $2.33

(6) Table 8-6 presents a summary of the Unit Day Value Method Assessment for recreation experience on a multi-purpose trail for cyclists, hikers, joggers, walkers and similar users.

Table 8-6
Unit Day Value Assessment for
Cyclists, Hikers, Walkers and Similar Users

	Judgment Factor Points		
Criteria	Without Proj	With Proj	Comments
Recreation Experience	4.0	10.0	Plaza would have a wider area for multiple use at one time, reducing crowding in the narrow area between the existing trail and levee. The tree shaded plaza and drinking fountains will provide a pleasant resting spot for users. The sloped pathways will give users easy access to the lower level River Walkway.
Availability of Opportunity	3.0	3.5	New plaza and amphitheater would provide a unique opportunity for users to enjoy various events during their use of this trail.
Carrying Capacity	4.0	7.5	New plaza and trail will allow the use of the site without deterioration of the resource. Gently sloped pathways leading to the River Walkway and seating area will replace the existing steep slope.

Accessi-bility	6.0	15.0	Exceptionally easy acces to the site from downtown streets and major expressway. Handicapped ramps will allow ready access to the site from the adjoining handicapped parking. Gentle slopes and a lift will allow easy access within the site.
Environ-mental	5.0	9.5	The garden plaza site will create a tree lined plaza with a view of the river, and an impressive view of the downtown Des Moines skyline.

Total Points:	Without Project 21	With Project 45.5
Point Value	$3.05	$4.43

Net increase in value per Trail Recreationist = $1.38

e. Anticipated Use of Riverfront Plaza and Amphitheater

(1) Amphitheater Users

(a) In estimating attendence at the various events that would be held at the Plaza/Amphitheater, it would be practical to assume that most of the events would attract audiences from within a thirty minute drive of the site. Weekday events will draw a majority of their attendance from the employees in the public and private office buildings in the area. As there will be no actual seats, seating capacity in the sloped area was estimated at between 850 to 1300 people, depending upon whether an individual occupied from 2- to 3-feet. A few hundred additional attendees could be accommodated in the over 7000-square foot "plaza" area.

(b) For attendees driving to the site, ample parking is within walking distance of the amphitheater. For weekend and evening performances, there are 810 public and private parking spaces within a two-block walk of the amphitheatre site. Over 650 additional spaces are available within a three-block walk of the site. (See Figure 8-2).

(c) Estimated use of the Riverfront Plaza and Amphitheater is based upon data from the City of Des Moines Planning Department, the Park and Recreation Department, the Chamber of Commerce, and other local sources on attendance at similar events held in past years and their estimates of projected attendance for future events. For instance, a total of 23,000 persons attended the eight jazz

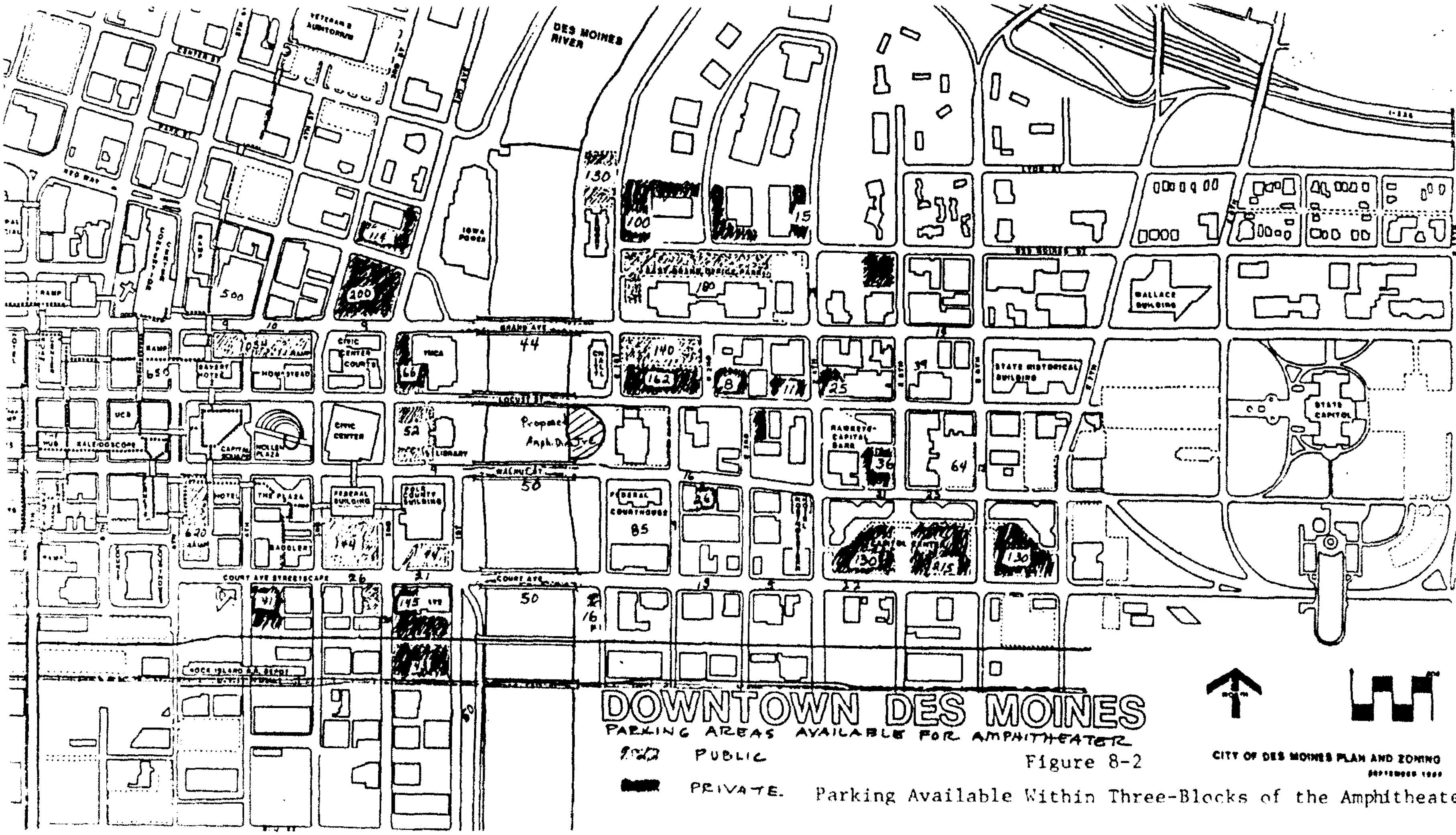

Figure 8-2

Parking Available Within Three-Blocks of the Amphitheater

concerts held in 1990, over 2800 persons for each event. The Des Moines City Manager's Newsletter, Spring 1992 issue reported that more than 1,000 bicyclists participated in the Mayor's Annual Bike Ride. Table 8-7 uses an estimated range of 200-500 participants.

(d) The City of Des Moines has created a 1993 Schedule of proposed activities and events to be held at the Amphitheater (See Figure 8-3). For purposes of estimating attendance, an upper limit of 1000 persons was used as the daily maximum attendance for a single event. It was assumed that events which consistently had low attendance would be replaced. Using the proposed schedule, a range of estimated usage for event attendees and for noon hour users was developed and is shown in Table 8-7.

Table 8-7
Estimated Use of Riverfront Plaza/Amphitheater

Activity	Times Per Season	Estimated Attendance: Range Per Event	Total for all Events: Low	Total for all Events: High
SCHEDULED USES:				
Children's Weekend	17	150 - 250	2,550	4,250
Variety Night	8	200 -1000	1,600	8,000
Classical Gas	10	350 -1000	3,500	10,000
October Fest	5	200 - 500	1,000	2,500
Holiday Caroling	4	300 - 500	1,200	2,000
Jazz Concerts	9	750 -1000	6,750	9,000
Brown Bag Series 25 wks/2 dys/wk	50	300 - 500	15,000	25,000
SPECIAL EVENTS:				
Two Rivers Festival	3 days	600 -1000	1,200	3,000
Mayor's Annual Bike Ride	1	200 - 500	200	500
Ruan Grand Prix	1	250 - 500	250	500
Estimated Range of Attendees:			35,300	67,250
Most Likely Attendance:				52,400
UNSCHEDULED USE:				
Noon Hour Users May-Oct 3 dys/wk	78	200 - 400	15,600	31,200
Most Likely Users:				24,300

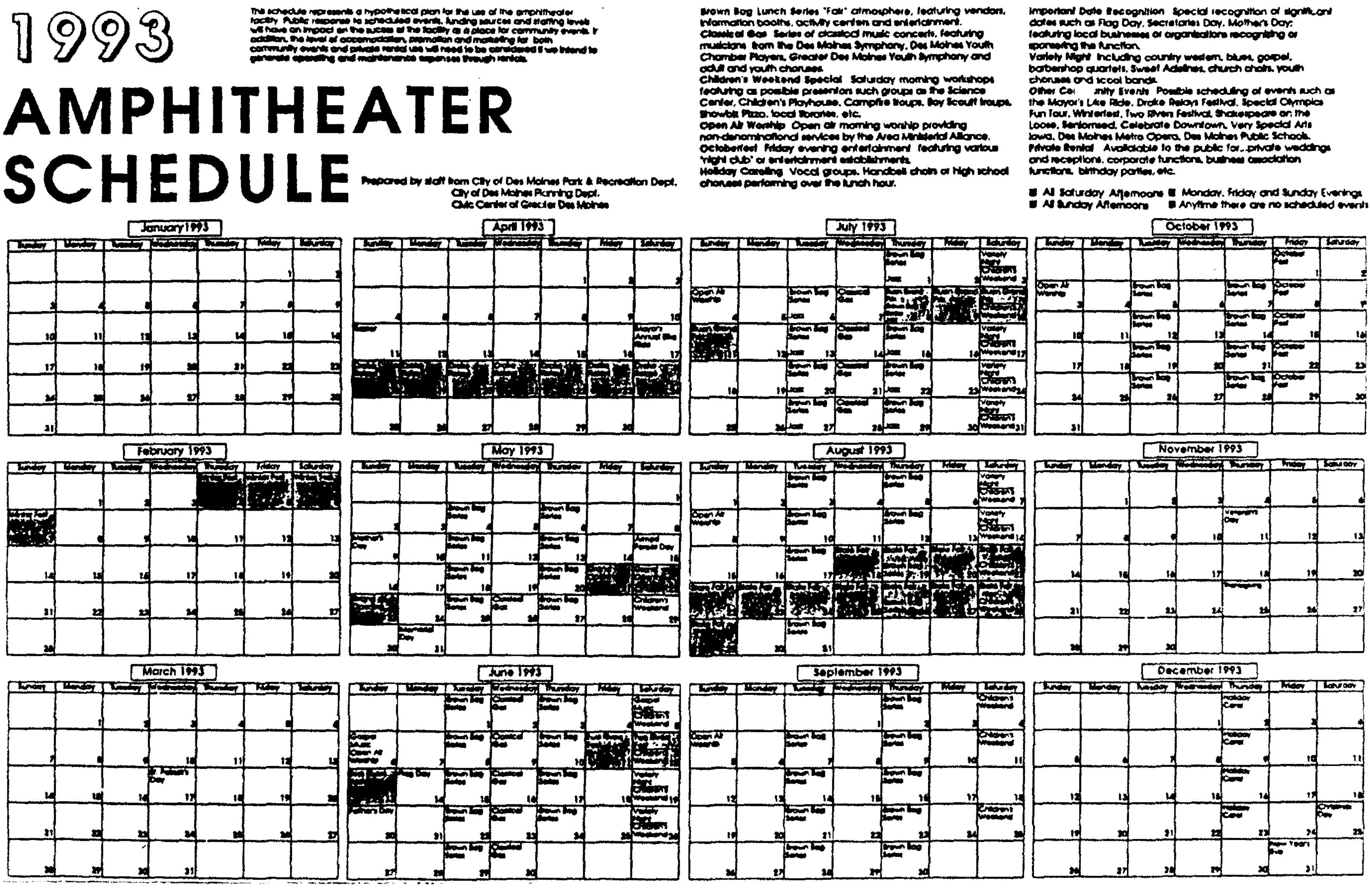

Figure 8-3 Proposed Amphitheater Schedule of Events

(e) As identified in Figure 8-3, other events can also be scheduled for the Riverfront Plaza/Amphitheater. No estimate of that attendance is included in this analysis.

(f) The proposed amphitheater will allow easy access by handicapped individuals and handicapped parking will adjoin the site. No special analysis was performed to determine the increase in estimated attendance based upon tapping into a new category of recreationist. With their inclusion, the resulting project benefits would increase.

(g) The Unit Day Value of using the site by noon hour users is $2.70 without the proposed project and $4.70 with the project, or a net increase of $2.00 per recreationist. For recreational use of the site in its existing condition as an amphitheater, the Unit Day Value is $2.64, and with the proposed project is $4.97, for a net increase of $2.33 per recreationist.

(2) Multi-Purpose Trail

(a) Using the design criteria detailed in the Greenbelt General Design Memorandum (GDM), an estimate of trail use by cyclists and hikers, based on the carrying capacity of that portion of the Riverfront Plaza multi-purpose trail, was developed. Based on the GDM Market Analysis, it was assumed that the trail segment would be fully utilized during the peak summer months of the recreation season.

(b) Survey data for Rock Island District managed recreation areas indicate that 80-percent of all recreation takes place on weekends. Following the methodology in the GDM, the maximum daily recreation use of the proposed new trail segment (without overcrowding) was converted to peak monthly use for cyclists and for hikers.

Cyclists/hikers:

128	-:-	0.4	x	4.3	=	1,376
peak daily use of new trail		percent of recreation occurring on one weekend day		weeks per month		peak monthly use of proposed trail

(c) In addition, from field observation of the number of present users from the large number of public and private office buildings within a four to five block walk of the site, it was assumed that on work days from June through August, 200 walkers/joggers per day would use the

trail. For these recreationists, it was assumed that the peak use would be during the noon hour, and that peak use days would be the three days a week when no events and activities were scheduled for the amphitheater.

(d) Since unfavorable weather conditions have a more detrimental effect on noon hour recreationists than weekend recreationists, no estimates for trail usage for November through March are included in these estimates.

(3) Noon Hour Walkers/Joggers:

Peak usage June/July/August	200/day * 39 Days	7,800
60% usage May and September	120/day * 26 Days	3,120
25% usage April and October	50/day * 32 Days	1,600
	Total Walkers	12,520

(a) Peak monthly use for cyclists and hikers was converted to estimated annual trail use by applying monthly recreation attendance trends at the Rock Island District reservoir complexes. Based on this data, the current annual recreation use of the 300-foot trail through Riverfront Plaza would be 7,130. This figure represents a conservative estimate of annual use, and it assumes no overcrowing. The total estimate for annual use on weekends by all trail users is 7,130 and for noon hour users is 12,520 for a total of 19,650 annual trail users.

(b) As indicated in Table 8-6 and Figure 1, the trail improvement would provide an enhanced recreation experience, improve accessibility to the River Walkway and to the East River Bike Trail recreation amenities, and increase the opportunity to view the environmental features of the area. These benefits are detailed in the Guidelines, Section VIII, paragraph 6-115 Unit Day Value Method.

(c) The Unit Day Value of one trail recreationist using the existing trail network is $3.05. Following completion of the proposed 300-foot trail, the value for trail users would increase by $1.38 cents to $4.43 per recreationist.

f. Average Annual Benefits

(1) Using the conservative recreation estimates above, Table 8-8 shows the average annual benefits for the proposed Riverfront Plaza and Amphitheater on the Des Moines River. Using the most likely attendance estimates, the average annual benefits for the Amphitheater and Riverfront Plaza amount to $197,800.

Table 8-8
Average Annual Benefits in Thousands

Activity and Unit Day Value Increase		Most Likely Number of Users	Average Annual Benefit
Amphitheater User	@ $2.33	52.4	$122.1
Noon Hour User	@ $2.00	24.3	48.6
Trail User	@ $1.38	19.6	27.1
Totals		96.3	$197.8

g. Average Annual Cost

(1) The project construction cost and the annual operation and maintenance costs detailed in this report are presented at June 1992 price levels. Interest during construction is not calculated as construction time will be less than one year. A detailed cost estimate is shown elsewhere in this report. Table 8-9 gives the average annual cost computed at an 8 1/2-percent discount rate for a 50-year Project Life.

Table 8-9
Summary of Annual Costs - Riverfront Plaza and Amphitheater
(June 1992 Price Levels)

Estimated Project Cost	$1,633,000
Annualized First Cost	$141,200
Annual Operation and Maintenance	3,800
Total Annual Cost	$145,000

h. Economic Summary

(1) Table 8-10 presents a summary economic analysis for the proposed recreation enhancement project. As indicated, the project is economically justified with a benefit-to-cost ratio of 1.36 and annual net benefits totalling $52,800.

Table 8-10
Benefits and Costs Summary
(8-1/2 Percent Discount Rate - June 1992 Price Levels)

Total First Cost	$1,633,000	
Annual Benefit		$197,800
Annual Cost	141,200	
Operation and Maintenance	3,800	
Total Annual Cost		$145,000
Annual Net Benefit		52,800
Benefit-to-Cost Ratio		1.36

i. Sensitivity Analysis

(1) This assessment measures those benefits realized by recreationists attending events at the amphitheater, pursuing activities on the multi-purpose trail, and noon hour uses. Attendance at these events was conservatively estimated.

(2) The attendance numbers presented in this report are derived from prior City of Des Moines sponsored activities and contain no inclusion of attendance figures at functions put on by businesses, societies, or individuals who would be using the amphitheater and garden plaza site for city approved purposes. For instance, as the starting or ending point for the "Red Flannel Run". This event is part of the Des Moines Annual WINTERFEST Celebration, is presented by the Riverfront YMCA and sponsored by local business establishments. Inclusion of the participants from this and similar events would increase the user and attendee totals used in computing the benefits for this project.

(3) To determine the effect of lower and higher attendance on the project, the benefit-to-cost was developed using the low and high attendance estimates from Table 8-7 and is shown below.

Table 8-11
Comparison Summary
(8-1/2 Percent Discount Rate - June 1992 Price Levels)

Estimated Users:	Low	High
Amphitheater Users	35,300	67,250
Cyclyists/Hikers, etc.	19,650	19,650
Noon Hour Users	15,600	31,200
Total Estimated Users	70,550	118,100
Estimated Annual Benefits	$140,600	$246,200
Total Annual Cost	145,000	145,000
Net Benefits	($4,400)	$ 101,200
Benefit-to-Cost Ratio	0.97	1.70

j. Financial Capability

The City of Des Moines, Iowa, has the willingness and capability to finance its share of the cost for the Riverfront Plaza and Amphitheater project. The sponsor will meet its services-in-kind and cash obligation with available funds. Given the amount of the financial obligation, financing the Riverfront Plaza and Amphitheater should have no negative impact on the sponsor.

9. PLAN IMPLEMENTATION

a. Schedule for Design and Construction

Table 9-1 presents the schedule of steps leading to completion of the project.

Table 9-1
Project Implementation Schedule

Requirement	Scheduled Date
Submission of Draft FDM to Corps of Engineers, North Central Division, for Review	Jun 92
Distribution of FDM for Public and Agency Review	Aug 92
Submission of Final and Public Reviewed FDM to North Central Division	Sep 92
FDM Approval by Corps of Engineers, North Central Division	Oct 92
Submit Final Plans and Specifications to North Central Division for Review and Approval	Feb 93
Obtain Approval of Plans and Specifications	Mar 93
LCA Approval by Assistant Secretary of the Army (Civil Works)	Apr 93
Advertise Contract	Apr 93
Award Contract	Jun 93
Complete Construction	Jun 94

b. Implementation Responsibilities

The Corps is responsible for preparing the design, obtaining a construction contract, and supervision and inspection of the construction. The local sponsor is responsible for reviewing the design and providing input as needed, obtaining the necessary right-of-way, paying for 50 percent of the total project cost, and operation and maintenance of the completed project.

c. Coordination

Close coordination between the Corps of Engineers and the City of Des Moines was maintained during the design period. A listing of meetings follows:

(a) 24 Oct 90. On-site meeting conducted with City of Des Moines (City), HLKB Architecture (HLKB) IDNR, and CENCR to perform initial coordination and site visit.

(b) 7 Nov 90. On-site meeting conducted with City, HLKB, Iowa State Historic Preservation Office (SHPO), and CENCR to discuss historic preservation, programming, economics, design alternatives, and project scope.

(c) 29 Nov 90. On-site meeting conducted with City, HLKB, and CENCR to discuss structural design aspects, develop list of required actions from each party, and review preliminary cost estimate for the project.

(d) 5 Dec 90. On-site meeting conducted with City, HLKB, SHPO, and CENCR to discuss scope of archaeological investigation and compliance of project to Section 106 of National Historic Preservation Act.

(e) 18 Dec 90. On-site meeting conducted with the City, HLKB, Midwest Gas Co., and CENCR to investigate the riverwall, discuss buried site utilities and the probable required high pressure gas line relocation, and to exchange CADD information.

(f) 5 Feb 91. On-site meeting conducted with the City, HLKB, and CENCR to review FDM progress and discuss design requirements to maintain the line-of-protection afforded by the levee segment on the project site which is part of the Des Moines (Stage I, Reach 3) Local Flood Protection Project.

(g) 5 Nov 91. On-site meeting conducted with the City, HLKB, and CENCR to review preliminary FDM design and discuss code requirements for handicapped accessibility to the stage.

10. RECOMMENDATION

I recommend the construction of the Downtown Riverfront Plaza/- Amphitheater, under the authority of the Des Moines Recreational River and Greenbelt, Iowa, at a Federal cost of $898,600. The total project cost would be $1,797,200, to be cost-shared 50 percent Federal/50 percent non-Federal. Non-Federal interests would be responsible for 100 percent of OMRR.

Albert J. Kraus
Colonel, U.S. Army
District Engineer

FINDING OF NO SIGNIFICANT IMPACT

DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM NO. 8
WITH ENVIRONMENTAL ASSESSMENT

DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER

DES MOINES, IOWA

I have reviewed the information provided by this Environmental Assessment, together with data obtained from cooperating Federal, State, and local agencies and the interested public. Based on this review, I find that the proposed amphitheater construction will not significantly affect the quality of the environment. Therefore, it is my determination that an Environmental Impact Statement is not required for this action. This determination will be reevaluated if warranted by later developments.

The alternatives considered along with the preferred action were:

- No Federal action.

- Other design strategies for plaza and stage components.

Factors considered in making the determination that an Environmental Impact Statement was not required are as follows:

a. The project will be located in a highly urbanized area with minimal natural resource or habitat value.

b. Initial losses of vegetation on the project site are not expected to affect long-term productivity of natural resources in the area.

c. No significant social, economic, environmental or cultural resources impacts are expected to result from this action.

____
Date

Albert J. Kraus
Colonel, U.S. Army
District Engineer

CORRESPONDENCE

APPENDIX A

DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM NO. 8
WITH ENVIRONMENTAL ASSESSMENT

DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER

DES MOINES, IOWA

APPENDIX A
CORRESPONDENCE

TABLE OF CONTENTS

State Historical Society of Iowa

The Historical Division of the Department of Cultural Affairs

December 21, 1990

In reply, refer to R&C Project #
90/11/77/050

Dudley M. Hanson, P.E.
Chief, Planning Division
Rock Island District, Corps of Engineers
Clock Tower Building--P.O. Box 2004
Rock Island, Illinois 61204-2004

RE: COE - POLK COUNTY - DES MOINES- DES MOINES RECREATIONAL RIVER AND GREENBELT DOWNTOWN RIVERFRONT PLAZA/AMPITHEATER ADJACENT TO CIVIC CENTER HISTORIC DISTRICT, A PROPERTY LISTED ON THE NATIONAL REGISTER OF HISTORIC PLACES - COMMENTS RELATIVE TO SECTION 106 REQUIREMENTS

Dear Mr. Hanson:

We write in response to your letter of November 15, 1990, concerning the above referenced project which was received in this office on November 27. We concur with the Corps recommendation for a Phase I archeological survey and reconnaissance effort to identify and document the presence of buried historic properties. As you are already aware, the project as proposed will extend into the Civic Center Historic District, a resource listed on the National Register of Historic Places and will have an effect on a portion of the riverwalls, which are a contributing element in that district. Because the property is listed on the National Register, this project is subject to the requirements of 36 CFR Part 800 and any change to the riverwalls and setting of the district should be in compliance with the Secretary of the Interior's Standards for Rehabilitation.

Based on our review of the conceptual design plans and two meetings and discussions with the architects, City of Des Moines staff, and Corps personnel, it is our sense that what is being proposed is generally sympathetic to the characteristics of the riverwalls and the setting within the district and can be considered to be compliant with the Secretary's Standards. Given the general direction things are going at present, we are likely to issue a finding of no adverse effect after we have a chance to review and comment on the final design plans and specifications for this aspect of the project.

Upon receipt of the archeological survey report and finalized design plans for the project, we will review the project formally and provide official comments on eligibility and effect. If you

402 Iowa Avenue
Iowa City, Iowa 52240
(319) 335-3916

Capitol Complex
Des Moines, Iowa 50319
(515) 281-5111

Montauk
Box 372
Clermont, Iowa 52135
(319) 423-7173

have questions or concerns relative to this project, please do not hesitate to contact me at 515/281-8697 or our archeologist Kathy Gourley at 515/281-8744.

Sincerely,

Ralph J. Christian, Consulting Architectural Historian
Review and Compliance Program
Bureau of Historic Preservation

cc: Ron Deiss, COE
Charlene D. Vaughn, Advisory Council on Historic Preservation
Patricia Zingsheim, Des Moines Planning and Zoning
Cal Lewis, Herbert Lewis Kruse Blunck Architecture
Des Moines Historic Preservation Commission
RF

United States Department of the Interior

Fish and Wildlife Service
Rock Island Field Office (ES)
1830 Second Avenue, Second Floor
Rock Island, Illinois 61201

TAKE PRIDE IN AMERICA

COM: 309/793-5800
FTS: 782-5800

March 20, 1991

Colonel John R. Brown
District Engineer
U.S. Army Engineer District
Rock Island
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Brown:

This refers to your letter of February 15, 1991, with enclosures, which describes plans to develop a public outdoor amphitheater in the City of Des Moines. The amphitheater is a feature of the Des Moines Recreational River and Greenbelt.

The project described should have no significant long-term impacts on fish and wildlife habitats. We have no other comments on the project.

These comments constitute the report of the Secretary of the Interior on the project within the meaning of Section 2(b) of the Fish and Wildlife Coordination Act, and should also fulfill the requirements of Section 7 of the Endangered Species Act.

Sincerely,

Richard C. Nelson
Field Supervisor

WF:sjg

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
726 MINNESOTA AVENUE
KANSAS CITY, KANSAS 66101

March 22, 1991

Colonel John R. Brown, USA
U.S. Army Engineer District, Rock Island
ATTN: Planning Division
Clock Tower Building - P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Brown:

This is in response to your request for comments on a proposed public outdoor amphitheater in the city of Des Moines to be constructed as part of the Des Moines Recreational River and Greenbelt project.

We have reviewed the information provided and have no comments to offer at this time. We look forward to reviewing the draft Environmental Assessment for this project.

Thank you for the opportunity to comment.

Sincerely,

for

Lawrence M. Cavin
Chief, Environmental Review
and Coordination Section

RECYCLE

STATE OF
IOWA

TERRY E. BRANSTAD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
LARRY J. WILSON, DIRECTOR

May 6, 1991

Dudley M. Hanson, P.E.
U.S. Army Engineer District, Rock Island
Clock Tower Building - P.O. Box 2004
Rock Island, IL 61204-2004
Attn: Charlene Carmack

Dear Mr. Hanson:

This letter is in response to your request to provide written comments on the potential environmental effects of the proposed public amphitheater along the Des Moines River in the city of Des Moines.

No significant environmental impacts were identified for the proposed project by our preliminary review. However, we do have some concerns as discussed below.

The amphitheater would project into the channel of the river, which is identified as floodway in the Des Moines Flood Insurance Study. Although computer modeling has shown the amphitheater would have minimal impact on flood flows and channel capacity, our concern is primarily one of precedence. Similar projects such as this along the riverfront could, in fact, have a cumulative impact on flood profiles as well as aquatic habitat. Des Moines is currently looking at the riverfront as a focal point for development and redevelopment so the potential for other riverfront projects that might infringe on the flood carrying capacity of the Des Moines River floodway exists. The city of Des Moines has stated that similar development is unlikely because of the public nature of this project and the fact that the city could control other development as the city owns most of the riverfront land in this reach. However, the city has not provided adequate documentation to back this claim and at this time it is not certain the project could receive the necessary Department approval.

Another concern we have identified is the fact that this facility could be submerged by floodwater. Although appropriate design would minimize flood damage, the fact is the amphitheater may be unusable for certain periods of time during the peak use season. A hydrologic analysis would be able to determine the frequency and duration of submergence on an average basis. If the frequency and duration of submergence is significant, this may eventually lead to a call for the Corps to alter the operation of Saylorville. Given the multiple purpose use of Saylorvile, it may be hard to provide the operational flexibility to accommodate the public use demands of this project.

WALLACE STATE OFFICE BUILDING / DES MOINES, IOWA 50319 / 515-281-5145 / TDD 515-242-5967 / FAX 515-281-8895

Thank you for the opportunity to comment and if you should have any questions, feel free to contact my staff.

Sincerely,

Larry L. Wilson
Director

CITY OF DES MOINES

OFFICE OF THE CITY MANAGER
CITY HALL
EAST FIRST AND LOCUST
DES MOINES, IOWA 50307
(515) 283-4141

ALL-AMERICA CITY 1949,1976,1981

June 26, 1991

Mr. Larry Wilson
Director
Iowa Department of Natural Resources
Wallace State Office Building
Des Moines, Iowa 50319

Re: City of Des Moines, Iowa
Amphitheater Bandshell Project
Des Moines River

Dear Mr. Wilson:

This letter is written in response to comments made by the Iowa Department of Natural Resources in your letter to Mr. Dudley M. Hanson, U.S. Army Corps of Engineers, dated May 6, 1991. It is my intent to assure you, and your staff, that the city of Des Moines recognizes the concerns raised by IDNR in the Amphitheater/Bandshell project communication. The city is prepared to provide procedures and information sufficient to meet needs expressed by your staff concerning our riverfront development plans.

Previously the city supplied to IDNR a hydraulic analysis of the Des Moines River section impacted by the Amphitheater project. As you indicate, that analysis is sufficient to demonstrate the Amphitheater project will have a negligible impact on flood profiles. The City is aware the project may be subject to periodic flooding, and as such, may sustain minor damages, or be unusable during high water periods of minor duration. Based upon our usage analysis, and our engineering and architectural analysis, city staff is prepared to recommend that the project proceed.

As you indicated in your communication to the Corps, the city of Des Moines has under development a Vision Plan concept, one focus of which is to more fully utilize the riverfront as an architectural and environmental amenity. The final Vision Plan document may call for specific projects fronting upon the Des Moines River in stretches as far north as Birdland Marina. Individual projects, residential, commercial, or public which are considered for construction as part of the Vision Plan, may or may not have an effect upon hydraulics and aquatic habitat of the river. Each project's exact location and detail will define the degree of analysis which must occur before approval.

When a riverfront project is recommended for construction, and the project results in a proposed encroachment into the flood plain, the City will commit to furnishing IDNR a hydraulic analysis, through the appropriate river stretch, showing the impact of that specific project. Without knowing which projects would be recommended for construction as part of a final Vision Plan document, we believe this incremental approach, on a project by project basis, is the most appropriate to the circumstances. IDNR staff will, on this basis, retain the ability to measure the cumulative effect of each project on the river's habitat and flood carrying capacity.

In your letter to the Corps of Engineers you made reference to the City's ownership of property fronting upon the river, and the safety factor this allows the City and IDNR in reviewing potential encroachments. It was my belief that the City's ownership records had been supplied to IDNR previously. If these records have not been provided they will be forthcoming shortly.

It has been a pleasure to work with your staff on our riverfront projects. We appreciate very much the professionalism exhibited by your personnel in responding to our past and on-going requests for assistance. If the project review concept contained herein is not sufficient to move ahead with the Amphitheater Project and other projects which have been discussed with IDNR personnel, I would appreciate hearing from you at the earliest opportunity.

Sincerely,

Cy Carney

Cy Carney
City Manager

RC

xc: Mr. Perry Hubert ✓

July 12, 1991

Real Estate Division

SUBJECT: Des Moines Recreational River and Greenbelt, Downtown Riverfront Plaza/Amphitheater Project, Des Moines, Iowa

Mr. Cy Carney
City Manager
City Hall
East First and Locust
Des Moines, Iowa 50307

Dear Mr. Carney:

Please reference a Rock Island District, Engineering Division letter to you dated January 31, 1991. The letter estimated the total value of the required right-of-way, acquisition, costs, and including a contingency for the subject project to be $75,000.00.

The $75,000.00 gross estimate was made assuming that fee simple title would be conveyed to the Government at the time construction was initiated. Credit will be based upon the fair market value of the fee interest value provided based upon Federal Rules of Compensation. In effect that means benefits as well as damage can be considered in estimating the change in value due to the project.

We must therefore eliminate the estimated $75,000.00 toward the City of Des Moines credit shown in the total project cost estimate. An appraisal of the property in its "before" and "after" condition will be needed. The property, probably, in its "after" condition will be worth more since it will have been improved with the Plaza/Amphitheater. It could be assumed that the appraisal will therefore result in no credit being assigned for the real estate interests required.

Sincerely,

W. M. Tait
Chief, Real Estate Division

State Historical Society of Iowa

The Historical Division of the Department of Cultural Affairs

July 15, 1991

In reply refer to:
RC# 901177050

District Engineer
U.S. Army Engineering District, Rock Island
ATTN: Planning Division; Dudley M. Hanson, P.E.; Chief
Clock Tower Building - P.O. Box 2004
Rock Island, Illinois 61204-2004

RE: COE - POLK COUNTY - DES MOINES - DES MOINES RECREATIONAL RIVER AND GREENBELT, DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER WITHIN THE CIVIC CENTER HISTORIC DISTRICT, A PROPERTY LISTED ON THE NATIONAL REGISTER OF HISTORIC PLACES - A FINDING OF CONDITIONAL NO ADVERSE EFFECT

Dear Mr. Hanson:

We have completed our review of the above-referenced project, based on the materials you submitted to us on June 6, 1991. The archeological investigations identified no significant historic properties, and the borrow sites selected contain no historic properties.

Based on the information provided, we have assessed the effects of the project on the Civic Center Historic District in accordance with 36 CFR Part 800.5. The work appears to be in compliance with the "Secretary of the Interior's *Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings.*" We would be willing to issue a finding of No Adverse Effect subject to the following conditions:

1. The Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings will be cited in all construction and bid documents.
2. Final architectural plans and specifications for this project will be submitted to the Review and Compliance Section of the Bureau of Historic Preservation for review and approval prior to commencement of the project.

Once these conditions are met, we will issue a finding of No Adverse Effect. You should include a copy of this letter with your documented finding to the Advisory Council on Historic Preservation as specified in 36 CFR Part 800.5(d) and described in 800.8(a). This report should be submitted to Mr. Don Klima, Advisory Council on Historic Preservation, The Old Post Office Building, 1100 Pennsylvania Avenue, N.W. #809, Washington, D.C. 20004.

402 Iowa Avenue
Iowa City, Iowa 52240
(319) 335-3916

Capitol Complex
Des Moines, Iowa 50319
(515) 281-5111

Montauk
Box 372
Clermont, Iowa 52135
(319) 423-7173

If you have questions, please do not hesitate to contact Ralph J. Christian, Consulting Architectural Historian of our Review and Compliance Program, at 515/281-8697.

Sincerely,

Judith Ann McClure

Judith Ann McClure, AIA
Preservation Architect
Bureau of Historic Preservation

cc: Patricia Zingsheim, City of Des Moines
✓Ron Deiss, Corps of Engineers
Cal Lewis, Herbert Lewis Kruse Blunck Architecture
Don Klima, Advisory Council on Historic Preservation
RF

Advisory Council On Historic Preservation

The Old Post Office Building
1100 Pennsylvania Avenue, NW, #809
Washington, DC 20004

SEP 4 1991

Mr. Dudley M. Hanson, P.E.
Chief, Planning Division
Rock Island District, Corps of Engineers
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

REF: Proposed Riverfront Plaza/Amphitheater
Des Moines, Iowa

Dear Mr. Hanson:

On August 26, 1991, the Council received the additional information to accompany your determination that the referenced project would not adversely affect the Civic Center Historic District, a property listed on the National Register of Historic Places. We have reviewed your supporting documentation and we agree with your determination.

This letter confirms that the requirements of the National Historic Preservation Act and the Council's regulations have been met for this project. Both this letter and your supporting documentation should be retained in your environmental or project files.

If you have any questions, please contact Valerie DeCarlo at (202) 786-0505. Thank you for your cooperation.

Sincerely,

Don L. Klima
Director, Eastern Office
of Project Review

IOWA DEPARTMENT OF NATURAL RESOURCES

CONSTRUCTION PERMIT

As provided under Chapter 111 of the Code of Iowa, the Department of Natural Resources, Wallace State Office Building, Des Moines, Iowa 50319-0034, hereby grants

RECEIVED
APR 7 1992
DEPT. OF ENGINEERING
CITY OF DES MOINES, IOWA

TO: City of Des Moines, Iowa
C/O Authorized Agent Mr. Harold E. Smith, P.E., City Engineer

OF: City Hall, Engineering Department
East First and Locust
Des Moines, Iowa 50307

permission to do the following work subject to stipulations stated herein and in the documents submitted in applying for this permit which is now on file in the central office of the Department of Natural Resources. Note: Any special conditions and stipulations contained in this permit will take precedence over plans/specifications provided by the applicant.

The Conservation Officer in charge of this area, Mr. Lon Lindenberg, 148 Patterson Street, Bondurant, Iowa 50035, telephone number 515/967-6407 shall be notified prior to the beginning of the construction and upon its completion so that it may be ascertained that the state's rights are being protected.

Permit authorizing the construction of the Des Moines Civic Amphitheatre on the east bank of the Des Moines River between Locust Street and Walnut Street.

Location is given as S.E. 1/4 of Section 4, Township 78 North, Range 24 West, East bank of the Des Moines River, R.M.202.2, between Locust Street and Walnut Street, Polk County, Iowa.

This permit is granted subject to the permittee obtaining all other permits from this department or any other governmental agency which may have jurisdiction in this area. Permittee is reminded of permit requirements of the U.S. Army Corps of Engineers in regard to dredging, filling, or construction activity. If it has not already been done, contact with these agencies should be made by permittee to determine if permits from them are required for this project.

This **Permit Expires:** December 31, 1994

The permittee is presumed to be familiar with all laws, ordinances, and regulations that may affect employees, materials, or equipment used in or upon the work. The Permittee shall indemnify and save harmless the State of Iowa, Department of Natural Resources, and all its officers and agents from claims or liability of any character arising out of any acts or damages that might result from the installation or construction of the project described in this permit.

Date of Issuance: *APRIL 6, 1992*

Permit Number: *92-36*

cc: U.S. Army Corps of Engineers
Conservation Officer's Supervisor
Conservation Officer
Iowa DNR Fish and Wildlife Section
Iowa DNR Floodplain Section

DEPARTMENT OF NATURAL RESOURCES

By: ______________________
(Director)

STATE OF
IOWA

TERRY E. BRANSTAD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
LARRY J. WILSON, DIRECTOR

April 28, 1992

RECEIVED
APR 29 1992
DEPT. OF ENGINEERING
CITY OF DES MOINES, IOWA

Mr. John Bryan
Office of City Manager
400 East First Street
Des Moines, IA 50309-1891

Dear John:

This is in response to our recent phone conversation regarding the proposed Des Moines River Amphitheater project.

In our letter of March 12, we outlined specific information which was needed for our review and approval of this project. The required information included the following:

- Demonstration of city control through ownership or easements over land within the Des Moines River floodway through the downtown reach.

- Detailed plans showing the actual project dimensions, changes to the Des Moines local flood protection works, and other engineering details.

Since that letter, we have received a map showing land ownership for that reach of the Des Moines River between the confluence with the Raccoon River and University Avenue. It appears from this information that the city owns all property within the floodway through this reach. This Department could, based on this information, approve the amphitheater project. However, it is highly unlikely we would approve any additional development on city owned land along the riverfront which would reduce the conveyance of the floodway unless the floodway limits along this reach were revised.

The project plans received to date do not provide the detail needed to complete our review. Specifically, the plans lack elevation information for the amphitheater stage and riverwalk. The plans also lack detail regarding modification of the city's flood protection works. If the final design for the project does not compromise the level of protection provided by the city's flood protection works and does not result in an additional obstruction of flood flows beyond that modeled by the HEC-2 run performed by Brice-Petrides-Donohue, this Department would permit this project. At this point, we feel the final design can meet those requirements but, final plans providing this detail are needed before the permit can be issued.

WALLACE STATE OFFICE BUILDING / DES MOINES, IOWA 50319 / 515-281-5145 / TDD 515-242-5967 / FAX 515-281-8895

We will proceed with the permitting of this project when final plans showing the required detail are received. If you have any questions regarding this matter, please contact me at (515) 281-8942.

Sincerely,

Bill Cappuccio
Staff Engineer
Water Quality Section

cc: Harold Smith, City Engineer

Ross Richardson, FEMA Region VII
911 Walnut Street
Kansas City MO 64106

STATE OF
IOWA
TERRY E. BRANSTAD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
LARRY J. WILSON, DIRECTOR

April 30, 1992

Mr. Robert W. Kelly, P.E.
U.S. Army Engineer District, Rock Island
ATTN: Engineering Division
P.O. Box 2004
Rock Island, IL 61204-2004

SUBJECT: Request for State Section 401 Certification
Construction of a riverfront Plaza/Amphitheater along the Des Moines River in Des Moines
Section 4, T78N, R24W, Polk County, Iowa

Water Quality Designation: The Des Moines River at this location is designated a Class B(WW) (significant resource warm water) water of the state. This water body is protected for secondary contact recreational uses and for fish, wildlife, aquatic and semiaquatic uses.

Dear Mr. Kelley:

This department has received and reviewed the request for state certification pursuant to Section 401 of the Clean Water Act. State Section 401 certification is required for the issuance of the Corps of Engineers Section 404 permit. Section 401 certification is the departments concurrence that a project is consistent with Iowa's Water Quality Standards.

This letter certifies that the department has determined that there is reasonable assurance the proposed activity will be conducted in a manner which will not violate water quality standards of the state of Iowa.

Sincerely,

Susan L. Millard

SUSAN L. MILLARD
WATER QUALITY SECTION

cc: Darrell Hayes, DNR, Info. & Coord. Division, LOCAL

WALLACE STATE OFFICE BUILDING / DES MOINES, IOWA 50319 / 515-281-5145 / TDD 515-242-5967 / FAX 515-281-8895

TY OF DES MOINES

OR JOHN P. DORRIAN
Y HALL
T FIRST AND LOCUST
MOINES, IOWA 50309
1 283-4944

CITY 1949,1976,1981

October 17, 1989

Colonel John R. Brown
District Engineer
U.S. Army Engineer District,
Rock Island
Clock Tower Building
P.O. Box 2004
Rock Island, IL 61204-2004

Dear Colonel Brown:

The City of Des Moines has reviewed the sample Local Cooperation Agreement which would apply to the Downtown Riverfront Plaza/Amphitheater located on property owned by the City of Des Moines between E. Walnut and E. Locust along the east side of the Des Moines River. The agreement includes the following obligations to be carried out by the City of Des Moines.

a. Provide, without cost to the Government, during the period of construction, all lands, easements, rights-of-way, and dredged material disposal areas, and perform all relocations and alteration of buildings, utilities, highways, railroads, bridges (except railroad bridges), sewers, and related and special facilities determined by the Government to be necessary for construction of the project.

b. If the value of the items in a. above is less than fifty percent (50 %) of total project costs, the City of Des Moines shall, during the period of construction, make such additional cash payments as are necessary to bring its total distribution in cash and value of lands, easements, rights-of-way, and utility and facility alterations and relocations, to an amount equal to fifty percent (50%) of total project costs.

c. Hold and save the Government free from all damages arising from the construction, operation, and maintenance of the project, except for damages due to the fault or negligence of the Government or its contractors.

d. Operate, maintain, replace, and rehabilitate the project or functional element thereof upon completion in accordance with regulations or directions prescribed by the Government.

e. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, approved January 2, 1971, in acquiring lands, easements, and rights-of-way for construction and subsequent operation and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

f. Comply with Section 601 of Title VI of the Civil Rights Act of 1964 (Public Law 88-352) and Department of Defense Directive 5500.11 issued pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations, as well as Army Regulation 600-7, entitled "Non-Discrimination on the Basis of Handicap and Programs and Activities Assisted or Conducted by the Department of the Army."

g. Prior to construction, and in accordance with the provisions of Section 221 of Public Law 91-611, the City of Des Moines will enter into a contract with the Government whereby the City of Des Moines will grant the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the City of Des Moines owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, repairing, maintaining, replacing or rehabilitating the project. If an inspection shows that the City of Des Moines for any reason is failing to fulfill its obligations under the Agreement without receiving prior written approval from the Government, the Government will send a written notice to the City of Des Moines. If the City of Des Moines persists in such a failure for 30 calendar days after receipt of the notice, then the Government shall have a right to enter, at reasonable times and in a reasonable manner, upon lands the City of Des Moines owns or controls for access to the Project for the purpose of completing, operating, repairing, maintaining, replacing, or rehabilitating the project. No completion, operation, repair, maintenance, replacement, or rehabilitation by the Government shall operate to relieve the City of Des Moines of responsibility to meets its obligations as set forth in the Agreement, or to preclude the Government from pursuing any other remedy at law or equity to assure faithful performance pursuant to the Agreement.

h. The City of Des Moines is willing and able to pay 50% of the total project cost, not to exceed $1.5 million. The City's share of the total project cost will include $400,000, plus any additional privately raised funds or donations plus the value of the land, the value of the construction easements and obstruction permits, and the value of any other specific engineering work and planning work eligible for cost share.

The City's financial participation in the project will follow the completion of a mutually agreeable design, the final determination of construction costs, and the execution of the Local Cooperative Agreement.

Sufficient funds have been privately pledged and can be raised quickly. The cash payment can be deposited directly with the Government, or in an escrow account, upon demand by the Government.

This is to advise that if the Downtown Riverfront Plaza/Amphitheater is approved by the City of Des Moines following design and specification and construction costs which indicate that the project is feasible and the successful negotiation of all necessary agreements and permits with the Corps of Engineers, the Department of Natural Resources and the State Historic Preservation Office and submitted for approval by the Corps of Engineers' higher authority, the City of Des Moines is willing, and legally and financially able, to sign the referenced Local Cooperation Agreement which includes the obligations set forth above.

To reiterate, the City of Des Moines intends to consider toward its local match the value of the land, the value of any surveys, easement rights, obstruction permits, specific project work performed by the City Planning Department and the City Engineering Department which is eligible for cost share.

Sincerely,

JOHN P. DORRIAN
Mayor

JPD/PZ:rd

Enclosures

Roll Call Number
89-4155

Agenda Item Number
59 B

Date September 25, 1989

WHEREAS, the Des Moines Recreational River and Greenbelt with local support was funded and conditionally authorized by Public Law 99-88, as approved on August 15, 1985; and

WHEREAS, the purpose of the Des Moines River Area and Greenbelt is to develop and manage natural resources, cultural features, outdoor recreation facilities, and environmental education programs in a manner that makes wise use of land and water resources and that attracts outdoor recreation use and economic development to the area; and

WHEREAS, a project called Downtown Riverfront Plaza is included in the formally adopted Greenbelt Master Plan for the site between Locust and Walnut on the east side of the Des Moines River; and

WHEREAS, the City of Des Moines, Iowa is a participant in the Advisory Committee and will continue to work with this Committee and the U.S. Army Corps of Engineers on planning the Des Moines Recreational River and Greenbelt Project; and

WHEREAS, a Letter of Assurance is required to formally initiate project-specific work and cost share for potential Des Moines Recreational River and Greenbelt projects specifically the proposed Downtown Riverfront Plaza;Amphitheater; and

WHEREAS, said Letters of Assurance are not a legally binding document, but rather are intended to demonstrate a good faith intent by potential local sponsors to participate with the U.S. Army Corps of Engineers assisted projects for the Greenbelt; and

WHEREAS, a private initiative has provided assurance that they will donate $400,000 to cost share with Federal Greenbelt funds for purposes of project construction; and

WHEREAS, the City of Des Moines would need to assign the land for this purpose and be responsible for long term maintenance; and

WHEREAS, the Plan and Zoning Commission has recommended that the City Council declare planning and redevelopment of the Riverfront and Greenbelt Project to be a top priority; and

WHEREAS, the Architectural Advisory Committee, the Parks and Recreation Board have recommended approval of the project concept subject to further design development; and

- Continued -

Call Number
89-4155

Agenda Item Number
59 B

Date September 25, 1989

WHEREAS, the project is compatible with the concept for the Civic Center Historic District which focused on the development of a publicly owned riverfront with civic building and public open space; and

WHEREAS, it is in the best interest of the citizens of the City of Des Moines that the attached Letter of Assurance be forwarded to the U.S. Army Corps of Engineers to demonstrate the good faith intent by the City of Des Moines to participate with the Corps of Engineers in design and construction of the Downtown Riverfront Plaza/Amphitheater; NOW, THEREFORE

BE IT RESOLVED by the City Council of the City of Des Moines, Iowa:

1) That the Mayor is authorized and directed to sign the attached Letter of Assurance and to submit it to the U.S. Corps of Engineers.

(Council Letter Number 89-505 attached)

MOVED BY Jorgensen to adopt.

FORM APPROVED:

Richard J. Boyle

Richard J. Boyle
City Solicitor

COUNCIL ACTION:	YEAS	NAYS	PASS	ABSENT
DORRIAN	✓			
VLASSIS	✓			
McPHERSON	✓			
JORGENSEN	✓			
BROOKS	✓			
FLAGG	✓			
OK	✓			
TOTAL	7			

MOTION CARRIED APPROVED

John P. Dorrian
Mayor

CERTIFICATE

I, DONNA V. BOETEL-BAKER, City Clerk of said City hereby certify that at a meeting of the City Council of said City of Des Moines, held on the above date, among other proceedings the above was adopted.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my seal the day and year first above written.

Donna V. Boetel-Baker
City Clerk

404(b)(1) EVALUATION

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B

DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM NO. 8
WITH ENVIRONMENTAL ASSESSMENT

DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER

DES MOINES, IOWA

APPENDIX B
SECTION 404(b)(1) EVALUATION

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APPENDIX B

CLEAN WATER ACT
SECTION 404(b)(1) EVALUATION

1. PROJECT DESCRIPTION

a. Location

The proposed placement site is located within Section 4, Township 78 North, Range 24 West, Polk County, Iowa (1956 Des Moines 7.5' U.S.G.S. quadrangle) along the left (east) bank of the Des Moines River between East Locust Street and East Walnut Street in downtown Des Moines, Iowa just upstream of river mile 202 (Figure 1).

b. General Description

(1) The project involves construction of a public outdoor amphitheater and public gathering area to serve as a park on the riverfront in downtown Des Moines. A round stage will intersect the existing Des Moines Riverwall and will span over the existing interceptor sewer/riverwalk. An extended riverwalk will protrude approximately 26 feet beyond the existing interceptor sewer into the Des Moines River. An arch (approximately 57'W x' 38'H) constructed of 12" tubular aluminum spans over the stage and serves as the focal point of the project as well as a support for user-furnished stage lighting, sound systems, banners, and decorations.

(2) The spectator area consists of formed grass slopes with concrete steps and walks rising to a concrete planter which doubles as a small floodwall to replace the upper 2.8 feet of the existing levee which is part of the Des Moines Local Flood Protection Project (LFPP). East of the planter is a tree-lined plaza with seating adjacent to select trees. A segment of the Des Moines Bike Path runs along the east edge of the site adjacent to the Embassy Suites.

c. Authority and Purpose

The Des Moines Recreational River and Greenbelt was funded and authorized by Public Law 99-88 as approved on August 15, 1985. The project is for the development, operation and maintenance of a recreational and greenbelt area on and along the Des Moines River in Iowa from U.S. Highway 20 in Fort Dodge, downstream to relocated U.S. Highway 92 in the vicinity of the Red Rock Dam. Development of the riverfront plaza/amphitheater is one of the projects included in the comprehensive plan for the Greenbelt.

d. General Description of Dredged and Fill Material

The stage area will be built above the existing riverwalk (interceptor sewer) and supported by concrete beams and 12" pipe piles. The riverwalk will be extended into the channel and supported by concrete beams and 12" pipe piles. Steel sheet piles will be driven under the outer perimeter of the extended riverwalk to form a partial cell which will be filled in during construction with granular material. See drawing plates 12 and 13 for plan and section views of this portion of the structure which will be built adjacent to and above the existing riverwalk (interceptor sewer).

e. Description of the Proposed Discharge Site

The placement of material for the stage and extended riverwalk structure will be along 83 linear feet of the left descending bank of the river. The height of the structure will extend to the top of the existing riverwall. The cavity under the extended riverwalk will be filled with granular material. The volume of water below the Ordinary High Water elevation of 780.5 NGVD replaced by granular material will be approximately 120 cubic yards. Aquatic habitat at the site is unknown, but is anticipated to be primarily sand and silt.

f. Description of Disposal Method

The extended riverwalk consists of a concrete slab on top of concrete beams supported by 12" pipe piles. The new riverwall and stage will also be supported by pipe piles (see drawing plates 12 and 13). The piles, granular material and concrete will be placed by mechanical means.

2. FACTUAL DETERMINATIONS

a. Physical Substrate Determinations

The substrate of the Des Moines River at the project site is generally composed of sand and silt.

b. Water Circulation, Fluctuation and Salinity Determinations

Water chemistry, clarity, color, odor, taste, dissolved gas levels, nutrients, and eutrophication will not be affected by the project. Salinity determinations are not applicable to the area. Circulation, flow, velocity, stratification and hydrologic regime will not be significantly affected. Water level fluctuations are influenced by Saylorville Reservoir which both stores and passes water in connection with its flood control purpose. The proposed project would cause no noticeable change in water level fluctuations. Current pattern will be slightly altered near the stage structure (See Appendix E for a discussion of hydraulics).

c. Suspended Particulate/Turbidity Determinations

There will be a minor temporary increase in suspended particulates and turbidity during construction. Following project completion, these factors should return to pre-construction levels.

d. Contaminant Determinations

Construction materials will be chemically stable and noncontaminating. Neither the fill material or its placement will cause relocation or increases of contaminants in the aquatic system. Certification of the project under Section 401 of the Clean Water Act has been received from the Iowa Department of Natural Resources in a letter dated April 30, 1992. This letter certifies the DNR's concurrence that the proposed project is consistent with Iowa's Water Quality standards (See Appendix A).

e. Aquatic Ecosystem and Organism Determinations

The proposed action should have no noticeable effect on the aquatic ecosystem. No significant impacts to benthos, plankton or nekton are anticipated. There are no refuges, wetlands, mud flats, vegetated shallows, coral reefs, or riffle and pool complexes in the project area. One Federally listed endangered species, the bald eagle (Haliaeetus leucocephalus), is listed for Polk County. It was determined that there would be no significant impacts to this species. No State-listed threatened or endangered species are known to occur within the project area, and no impacts are anticipated.

f. Proposed Placement Site Determinations

The proposed project may cause minor, temporary increases in turbidity during construction; however, no violations to water quality standards should occur. The proposed action will have no adverse effect on municipal or private water supplies; recreational or commercial fisheries; or water-related recreation, aesthetics, parks, national historic monuments, or similar preserves.

g. Determination of Cumulative Effects on the Aquatic Ecosystem

Impacts from construction would be temporary. The structure would be permanent and composed of physically stable, noncontaminating material. Therefore, no detrimental cumulative or secondary impacts are expected to occur.

h. Determination of Secondary Effects on the Aquatic Ecosystem

No adverse secondary effects are expected. The project site is located on an intensely developed reach of the Des Moines River, between two low-head dams, with little or no instream recreational or commercial activity.

3. FINDINGS OF COMPLIANCE WITH THE RESTRICTION ON DISCHARGE

a. No significant adaptations of the 404(b)(1) guidelines were made relative to this evaluation.

b. The alternative of No Federal Action was not feasible because it did not allow development of the stage structure at the amphitheater site.

c. Certification under Section 401 of the Clean Water Act has been obtained from the State of Iowa, Department of Natural Resources (See Appendix A).

d. The project will not introduce toxic substances into the waters of the United States or result in appreciable increases in existing levels of toxic materials.

e. No significant impact to Federally listed endangered or threatened species is anticipated from this project.

f. The project is located along a freshwater inland river system. No marine sanctuaries are involved or will be affected.

g. No municipal or private water supplies will be affected. Minor, temporary impacts to water quality will occur during construction. There will be no adverse impacts to recreational or commercial fishing. No adverse changes to the ecology of the river system will result from this action.

h. Because stable and noncontaminating materials will be used in this project, no contamination of the river is anticipated.

i. No other practical alternatives have been identified. The proposed actions are in compliance with Section 404(b)(1) of the Clean Water Act, as amended.

____
Date

Albert J. Kraus
Colonel, U.S. Army
District Engineer

GEOTECHNICAL EXPLORATIONS

APPENDIX C

DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM No. 8
WITH ENVIRONMENTAL ASSESSMENT

DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER

DES MOINES, IOWA

APPENDIX C
GEOTECHNICAL

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APPENDIX C
GEOTECHNICAL

1. REGIONAL AND SITE GEOLOGY

The city of Des Moines is located at the confluence of the Des Moines and Raccoon Rivers, at the southern edge of a Pleistocene glacial feature known as the Des Moines or Cary lobe. The surface material of the lobe was deposited during the last episode of glaciation, 14,000 to 13,000 years ago upon older glacial sediments lying on rock. At approximately this time, the Des Moines River changed its course from the valley east of Capitol Hill to its present location; making this reach of the valley newer and more narrow, with the bedrock close to the surface and alluvial deposits relatively thin. Top of rock is at approximately 750 feet elevation and consists of Pennsylvanian age cyclothemic deposits of argillaceous siltstones, some with calcareous cement, and silty shales. Extensive interbedding of silts and clays causes a varved or layered appearance. The regional dip of beds is generally to the southwest, with local bedding essentially horizontal. Some local structural features produce bedding planes approaching 15 degrees. This angle is not however, consistently repeated throughout the full core run and should present no structural problems.

2. SITE INVESTIGATIONS

a. On site investigations were conducted for soil, rock, and concrete from 28-30 January 1991. Three soil and rock borings and three concrete cores were completed. Locations for each are shown on Plate C-1, and Drawing Plate 6. Additionally, soil boring DM-6, taken in October 1984, is located on Drawing Plate 6; and, its log is shown on Drawing Plate 4.

b. Due to extreme cold, significant difficulty was encountered in all forms of drilling, especially the soil and rock exploration. Consequently, in only one hole, DA-91-1, was a complete set of soil samples recovered. The other two holes were advanced with hollow stem augers to the top of rock. Two inch split-spoon samples were taken every two and one half, or five feet, depending on soil type and sampling conditions. No remarkable differences were noted in the augered material from the other two holes compared to

the samples from DA-91-1; and the material appears to be relatively uniform across the site. In holes DA-91-1 and DA-91-2, approximately five feet of rock core was recovered using a five foot NQ(1-7/8in.) core barrel. Hole DA-91-3 was advanced to refusal at a depth of 51.1 feet; however, due to an increase in surface elevation, there was insufficient drill rod to core rock. Material recovered from the tip of the auger, however, was similar to the argillaceous siltstone cored in holes 1 and 2. Nominal top of rock was encountered in the three holes respectively at 750.6, 750.9, and 748.4 feet elevation. While glacial erosional channels cannot be ruled out, this elevation is probably indicative of the general top of rock throughout this area.

c. Four inch horizontal concrete cores were taken through the face of the river wall which consists of a newer outer wall facing over an older wall. Core number DA-1C went through the newer wall and then encountered a clay tile weep hole and form-tie hole in the old wall; both were filled with soil. Core number DA-2C, taken in the same general vicinity, produced good samples of both the new and old walls. The new-wall specimen contained a piece of rebar, and thus only the old-wall specimen was suitable for compressive strength testing. The third core produced testable specimens from both the new and old walls.

3. GEOPHYSICAL INTERPRETATION

a. The unconsolidated overburden consists of fill on Recent alluvial deposits of sands, silts, and clays, with N values in the 1 to 5 range. These overlie glacial deposits of sands and gravels, beginning at approximate elevation 767 feet, with N values from 13 to 15. Blow counts of 5 or below indicate a very loose condition, and sand with blow counts below 10 must be compacted prior to construction. Bearing capacities for these soil types may range from 1 to 2 tsf for the upper finer grained material, to 4 to 6 tsf for the coarser glacial materials. It is recommended that the foundation not be founded in the Recent alluvial deposits because of its very loose condition.

b. Unconfined compressive strength testing was conducted on two samples of calcareous siltstone from DA-91-1 and one sample of shale from DA-91-2. The siltstone samples failed at 12,198 and 10,324 psi, and the shale at 1817 psi. The extensive interbedding of the material precluded obtaining additional samples of sufficient length for compressive strength testing. Also, due to this interbedding, a Rock Quality Designation Index (RQD) assessment was not made. Generally the siltstones could be expected to have a bearing capacity between 15 and 25 tsf, and the shale between 8 and 12 tsf; a figure between 10 and 20 tsf could be expected for the entire rock unit.

Detailed drilling logs for holes 1 and 2 are attached as Plates C-2 and C-3, and photographs of the cores as Plate C-5.

c. Concrete compressive strength test results for old-wall samples from cores 2C and 3C were 4320 and 4101 psi, respectively. A new-wall sample from core 3C tested 6282 psi. In cores 1C and 2C, there was no bond between the old and new concrete; core 3C exhibited some mechanical bonding between the two. Detailed descriptions of the cores are recorded on the drilling logs Plates C-6 thru C-8, and photographs showing concrete coring locations are at Plate C-9. Exact locations for all coring are shown on the attached sketch (Encl 5).

4. CONSTRUCTION CONSIDERATIONS

a. Ground water was encountered in DA-91-1 at an elevation of approximately 777 feet and is probably controlled essentially at that elevation by the river wall/interceptor sewer complex, with a slight increase to be expected landward from the river. The levee in this reach is 3.7 feet in height and was designed with 3 feet of freeboard. In the event there is a design flood the hydraulic head will only be 0.7 feet; therefore, no seepage distress is expected. Additional drainage comments are in the Hydrology and Hydraulics Appendix.

b. To preclude placing additional load on existing structures, a pile foundation is anticipated thereby eliminating settlement problems. Due to the interbedded nature of the rock, it is anticipated that piles will probably achieve refusal within 2 to 3 feet penetration of the siltstone. Design strength parameters are estimated at phi of 51 degrees and a q_u of 2000 psi, with the governing factor being the capacity of the pile.

c. Potential spoil and borrow areas have been identified. The borrow area at Soldier Field was tested and approved for use in the Des Moines LFPP Definite Project Report, Section 205 Flood Control Project, Raccoon River, Des Moines, Iowa.

Exhibit 1-MEMORANDUM FOR RECORD, Trip Report, Geotechnical Explorations, Des Moines Recreational River and Greenbelt, Downtown Riverfront Plaza/Amphitheater, Des Moines, Ia, dated 11 Februrary 1991.

CENCR-ED-G 11 February 1991
Mr. Hotchkiss/gh/6290

MEMORANDUM FOR RECORD

SUBJECT: Trip report, Geotechnical Explorations, Des Moines Recreational River and Greenbelt, Downtown Riverfront Plaza/Amphitheater, Des Moines, IA

1. During the period 28-30 January 1991, ED-G personnel George Millar, Jerry Wickersham, and Glen Hotchkiss conducted soil sampling, rock coring, and concrete coring in support of the subject project. Three soil and rock borings and three concrete cores were completed. Locations for each are shown on the accompanying sketch (Plate C-1) and drawing Plate 6.

2. Due to extreme cold, significant difficulty was encountered in all forms of drilling, especially the soil and rock exploration. Consequently, in only one hole, DA-91-1, was a complete set of soil samples recovered. The other two holes were advanced with hollow stem augers to the top of rock. Two inch split-spoon samples were taken every two and one half, or five feet, depending on soil type and sampling conditions. No remarkable differences were noted in the augured material from the other two holes as compared to the samples from DA-91-1, and the material appears to be relatively uniform across the site. The unconsolidated overburden consists of fill on Recent alluvial deposits of sands, silts, and clays, with N values in the 1 to 5 range. These overlie glacial deposits of sands and gravels, beginning at approximate elevation 767, with N values from 13 to 15.

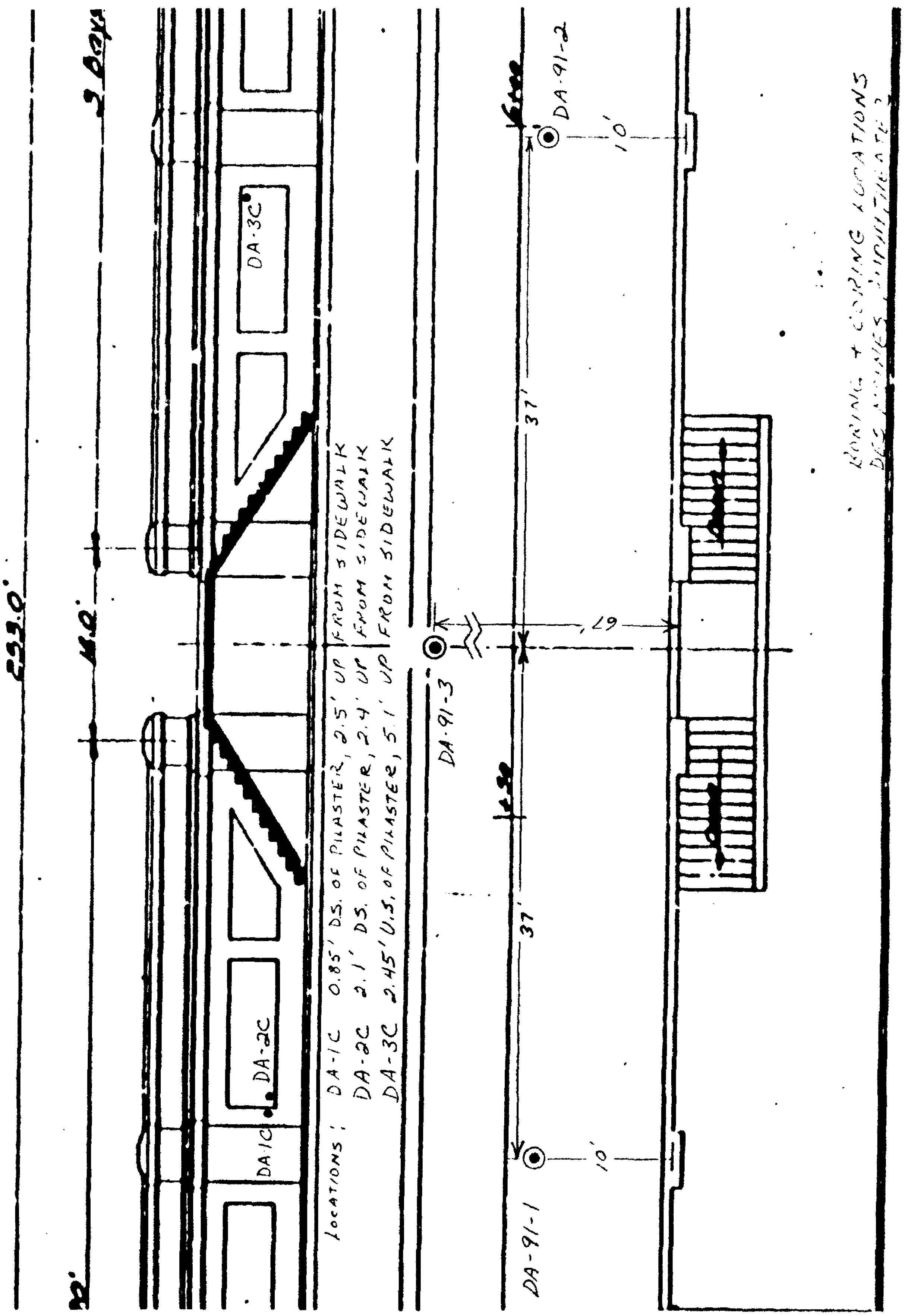
3. In holes DA-91-1 and DA-91-2, approximately five feet of rock core was recovered using a five foot NQ(1-7/8in.) core barrel. Bedrock consists of Pennsylvanian age cyclothemic deposits of argillaceous siltstones, some with calcareous cement, and silty shales. Extensive interbedding of silts and clays causes a varved appearance. The bedding is essentially horizontal; although, local structural features may produce bedding planes approaching 15 degrees. This angle is not however, consistently repeated throughout the full core run. Hole DA-91-3 was advanced to refusal at a depth of 51.1 feet; however, due to an increase in surface elevation, the drill crew had insufficient rod to core rock. Material recovered from the tip of the auger, however, is similar to the argillaceous siltstone cored in holes 1 and 2. Nominal top of rock was encountered in the three holes respectively at 750.6, 750.9, and 748.4 feet elevation. While glacial erosional channels cannot be ruled out, this elevation is probably indicative of the general top of rock throughout this area. Compressive strength testing was

conducted on two samples of calcareous siltstone from DA-91-1 and one sample of shale from DA-91-2. The siltstone failed at 12,198 and 10,324 psi, and the shale at 1817 psi. The extensive interbedding of the material precluded obtaining additional samples of sufficient length for compressive strength testing.

Also, due to this interbedding, a Rock Quality Designation Index (RQD) assessment was not conducted. Detailed drilling logs for holes 1 and 2 are attached as Plates C-2 through C-4 and photographs of the cores as Plate C-5.

4. Four inch horizontal concrete cores were taken through the face of the river wall which consists of a newer outer wall facing over an older wall. Core number DA-1C went through the newer wall and then encountered a clay tile weep hole and form-tie hole in the old wall; both were filled with soil. Core number DA-2C, taken in the same general vicinity, produced good samples of both the new and old walls. The new-wall specimen contained a piece of rebar, and thus only the old-wall specimen was suitable for compressive strength testing. The third core produced testable specimens from both the new and old walls. Compressive strength test results for old-wall samples from cores 2C and 3C were 4320 and 4101 psi, respectively. A new-wall sample from core 3C tested 6282 psi. In cores 1C and 2C, there was no bond between the old and new concrete; core 3C exhibited some mechanical bonding between the two. Detailed descriptions of the cores are recorded on the drilling logs (Plates C-6 through C-8), and photographs showing concrete coring locations are at Plate C-9. Exact locations for all drilling are shown on the attached sketch (Plate C-1).

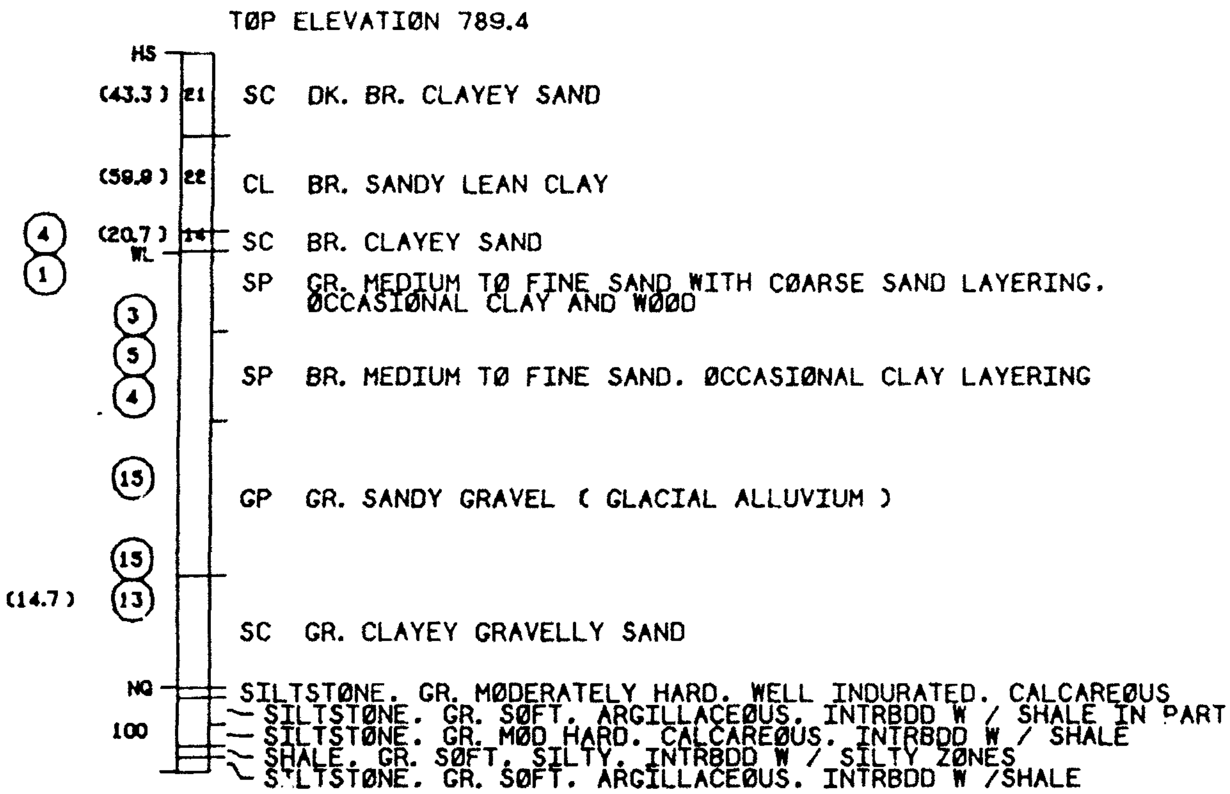
GLEN A. HOTCHKISS
Geologist



233.0'
14.0'
3 Bays
DA-3C
DA-2C
DA-1C
LOCATIONS: DA-1C 0.85' D.S. OF PILASTER, 2.5' UP FROM SIDEWALK
DA-2C 2.1' D.S. OF PILASTER, 2.4' UP FROM SIDEWALK
DA-3C 2.45' U.S. OF PILASTER, 5.1' UP FROM SIDEWALK
DA-91-1
DA-91-2
DA-91-3
37'
37'
10'
10'
67'
BORING + CORING LOCATIONS

PLATE C-1

DA-91-1



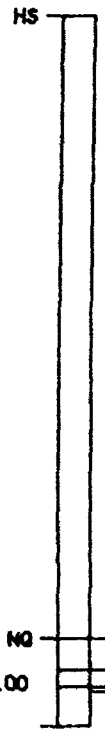
SEE PLAN SHEET FØR
LØCATIØN ØF BØRING
28 JANUARY 1991

DES MØINES AMPHITHEATER

SCALE: 1IN= 10FT

DA-91-2

TØP ELEVATIØN 789.0



BR. SANDY LEAN CLAY AND CLAYEY SAND ØVERLYING
ALLUVIAL SANDS AND GRAVELS (SEE DA-91-1)
(HØLLØW STEM AUGER TØ REFUSAL. NØ ØVERBURDEN SAMPLES)

SILTSTØNE. GR. SØFT. ARGILLACEØUS. W / INTRBDD SHALE IN PART
SHALE. GR. SØFT. SILTY
SILTSTØNE. GR. SØFT. ARGILLACEØUS. W / FINELY INTRBDD SHALE
SILTSTØNE. GR. MØDERATELY HARD. ARGILLACEØUS. PØØRLY BEDDED

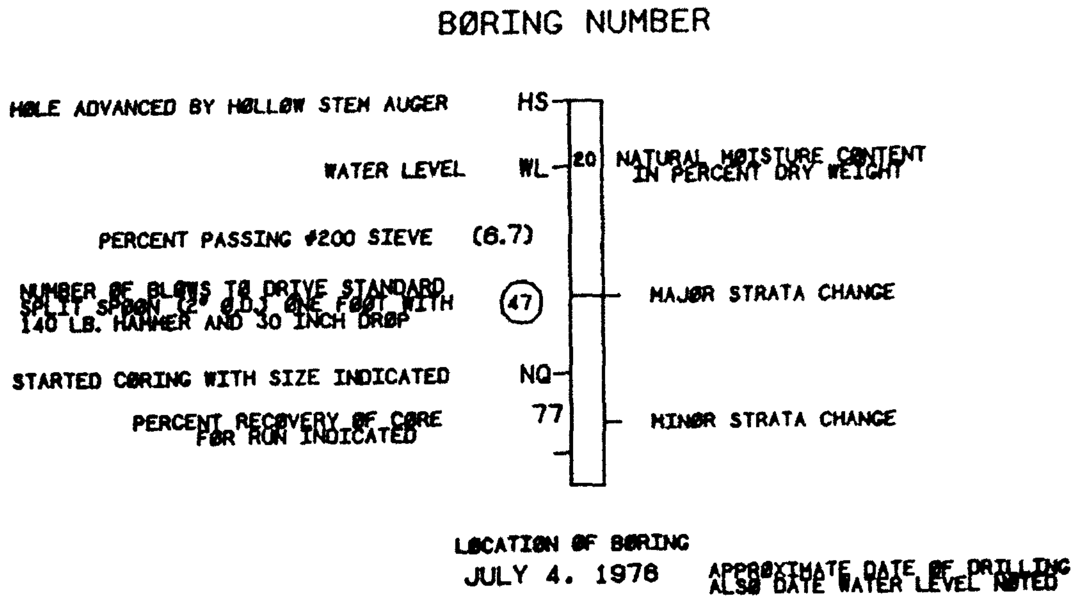
SEE PLAN SHEET FØR
LØCATIØN ØF BRØING
29 JANUARY 1991

—— NØ RECØRD ØF WATER LEVEL

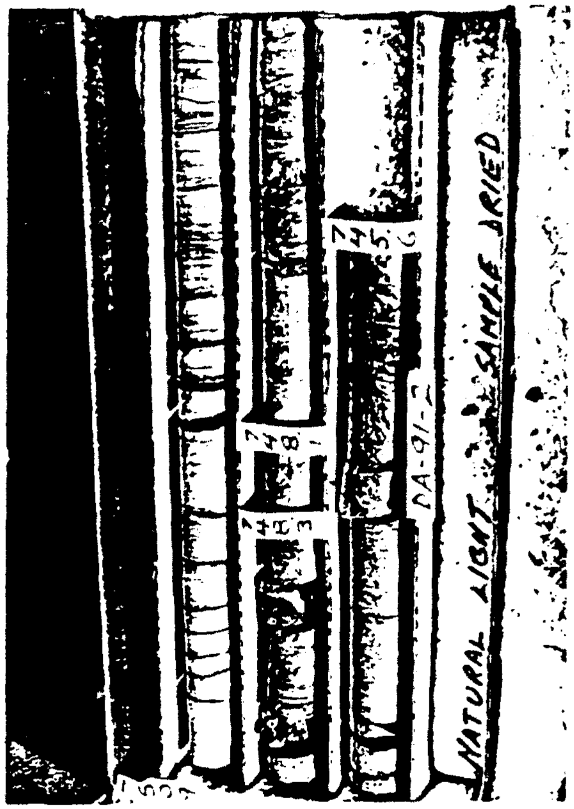
DES MØINES AMPHITHEATER

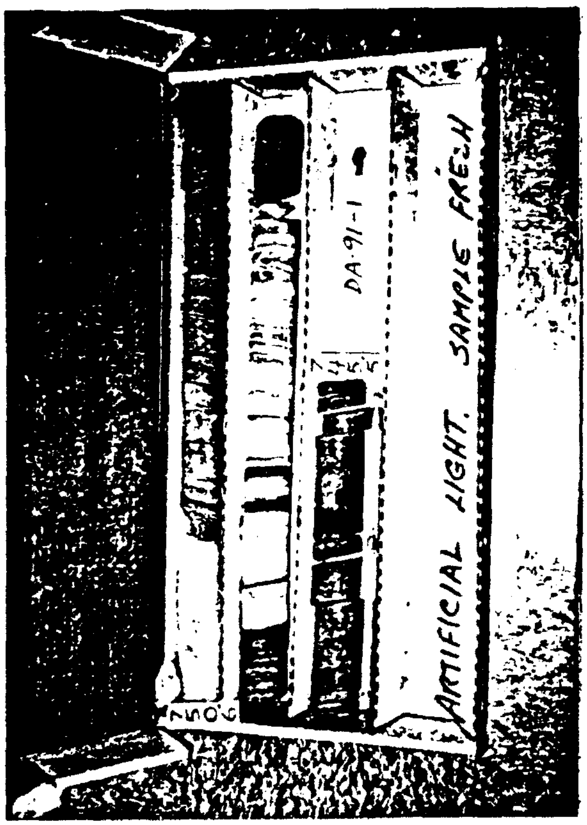
SCALE. 1IN= 10FT

LEGEND


BØRING NUMBER
HØLE ADVANCED BY HØLLØW STEM AUGER
HS
WATER LEVEL
WL
20
NATURAL MØISTURE CONTENT IN PERCENT DRY WEIGHT
PERCENT PASSING #200 SIEVE
(6.7)
NUMBER ØF BLØWS TØ DRIVE STANDARD SPLIT SPØØN (2" Ø.D.) ØNE FØØT WITH 140 LB. HAMMER AND 30 INCH DRØP
47
MAJØR STRATA CHANGE
STARTED CØRING WITH SIZE INDICATED
NQ
PERCENT RECØVERY ØF CØRE FØR RUN INDICATED
77
MINØR STRATA CHANGE
LØCATIØN ØF BØRING
JULY 4. 1976
APPRØXIMATE DATE ØF DRILLING ALSØ DATE WATER LEVEL NØTED


DA-91-2
ARTIFICIAL LIGHT. SAMPLE FRESH


DA-91-2
NATURAL LIGHT SAMPLE DRIED


DA-91-1
ARTIFICIAL LIGHT. SAMPLE FRESH

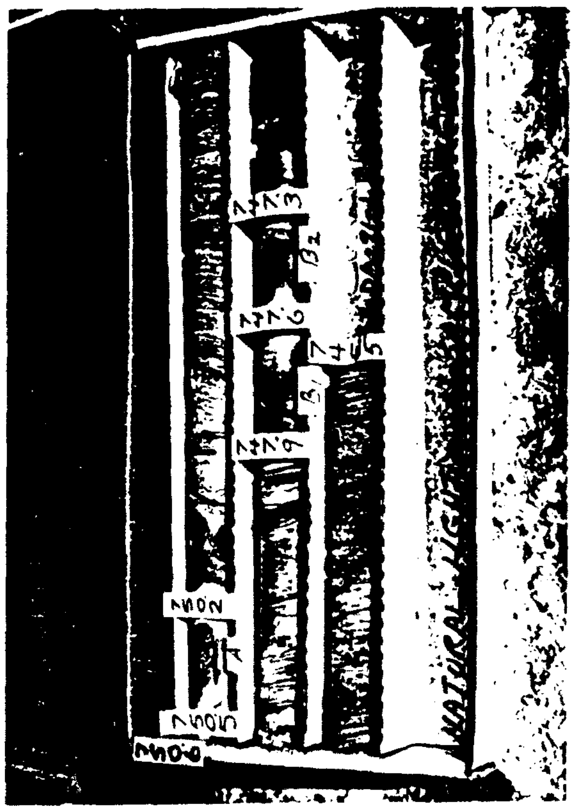


PLATE C-5

Hole No. DA-1C

DRILLING LOG	DIVISION NCD	INSTALLATION NCR-ED-G	SHEET 1 OF 1 SHEETS

1. PROJECT: Des Moines Amphitheater
2. LOCATION (Coordinates or Station) (see sketch): Approx. sta. 5+28, 2.5' upwall from sidewalk
3. DRILLING AGENCY: ED-G
4. HOLE NO. (As shown on drawing title and file number): DA-1C
5. NAME OF DRILLER: Wickersham/Hotchkiss
6. DIRECTION OF HOLE: ☐ VERTICAL ☐ INCLINED Horizontal DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN
8. DEPTH DRILLED INTO ROCK
9. TOTAL DEPTH OF HOLE 1.60'
10. SIZE AND TYPE OF BIT 4" Thinwall
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
12. MANUFACTURER'S DESIGNATION OF DRILL: Truco
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED | UNDISTURBED
14. TOTAL NUMBER CORE BOXES
15. ELEVATION GROUND WATER
16. DATE HOLE: STARTED 29 Jan 91 | COMPLETED 29 Jan 91
17. ELEVATION TOP OF HOLE
18. TOTAL CORE RECOVERY FOR BORING %
19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) e
			* See description below	
	0.25			
	0.5	0.45	Broken to retrieve core. Shear is through coarse aggregate.	
	0.75	0.67	Newer wall. Older wall.	
	1.0 – 1.5		No bond noted between new and old wall. A clay tile weep hole in the old wall was encountered at 0.67 and extends to the bottom of the core. The clay tile and the form tie hole were full of soil. The concrete contains about 1/2" maximum size natural gravel coarse aggregate and natural sand fine aggregate. The paste is hard and dense and does	
	1.75 – 2.0	1.60	not appear to be air entrained. There are numerous entrapped air voids. No reinforcing encountered.	
			* The newer wall concrete has 1" maximum size natural gravel coarse aggregate with natural sand fine aggregate. The coarse aggregate consists of a variety of igneous and sedimentary rock types. The aggregates appear to be reasonably well graded. The paste is hard and dense and does not appear to be air entrained. The core was taken over what looks like a form tie. The tie hole was patched to a depth of about 0.5 feet. Below that depth, the 1 1/4 inch depth tie hole is open to the bottom of the core. A #4 rebar was encountered at 0.33' depth.	

Hole No. DA-2C

DRILLING LOG	DIVISION NCD	INSTALLATION NCR-ED-G	SHEET 1 OF 1 SHEETS

1. PROJECT Des Moines Amphitheater	10. SIZE AND TYPE OF BIT 4" Thinwall
2. LOCATION (Coordinates or Station) Approx. sta. 5+30.5, 2.4' upwall from sidewalk (see sketch)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY ED-G	12. MANUFACTURER'S DESIGNATION OF DRILL Truco
4. HOLE NO. (As shown on drawing title and file number) DA-2C	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER Wickersham/Hotchkiss	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED Horizontal DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED 29 Jan 91 — COMPLETED 29 Jan 91
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 1.70'	19. SIGNATURE OF INSPECTOR

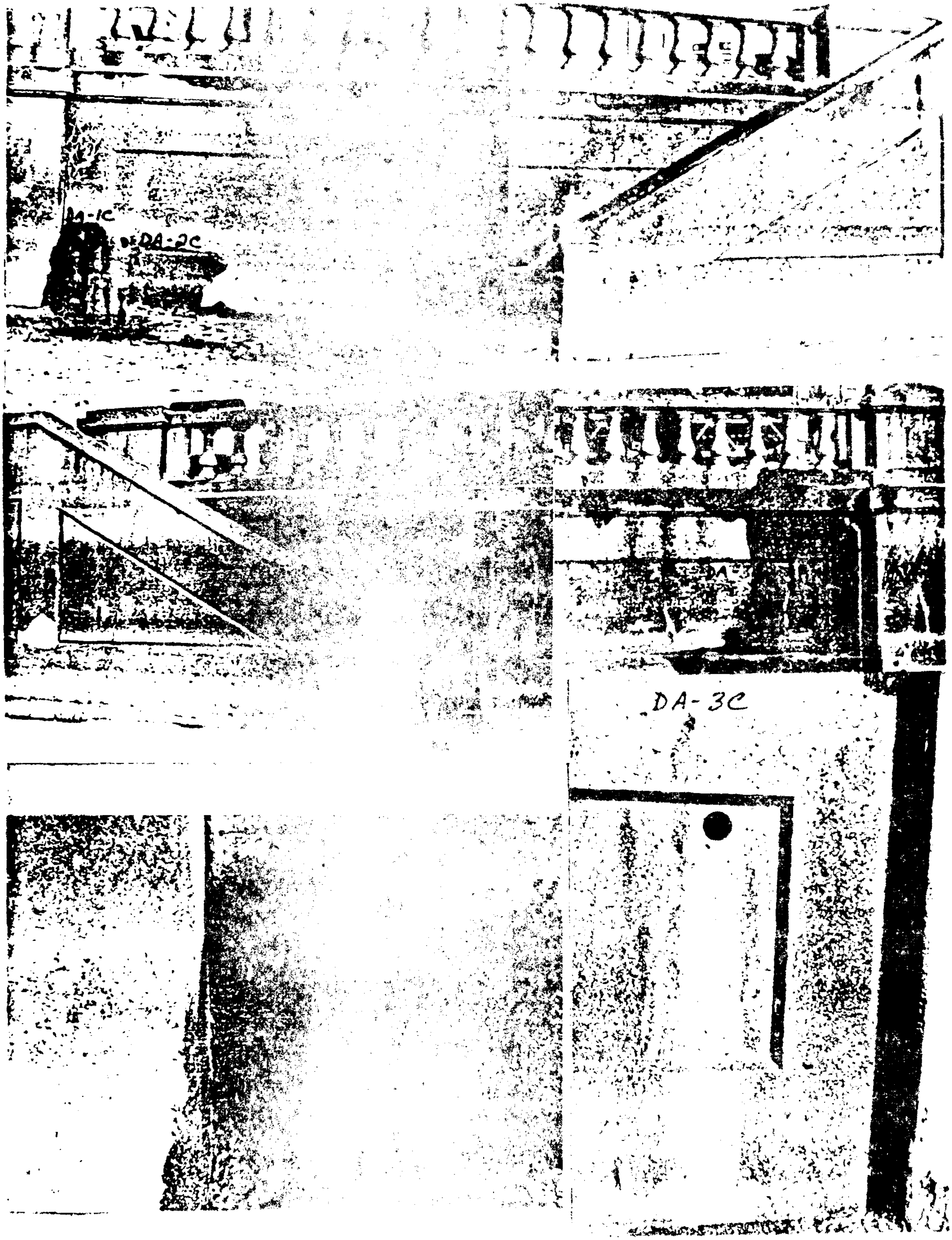
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) e
	0.25		#4 rebar vertical and horizontal encountered at 0.25' depth. Concrete in newer wall is as described in Core # DA-1C.	
	0.5	0.55	Newer wall	
			Older wall	
	0.75		No bond noted between new and old wall. Surface is dirty. Concrete in older wall is as described in Core #1 except maximum size of coarse aggregate is 1 1/2". No reinforcing encountered.	Compressive Strength = 4,320 p.s.i. S.S.D. Unit Weight = 146.8 lbs/cu. ft. Pulse Velocity = 6.678 f.p.s.
	1.0			
	1.25			
	1.5			
	1.75	1.70	Broken to retrieve core.	
			Shear is through and around coarse aggregate.	

Hole No. DA-3C

DRILLING LOG	DIVISION NCD	INSTALLATION NCR-ED-G	SHEET 1 OF 1 SHEETS

1. PROJECT Des Moines Amphitheater	10. SIZE AND TYPE OF BIT 4" Thinwall
2. LOCATION (Coordinates or Station) (see sketch) Approx. sta. 5+95, 5.1'upwall from sidewal	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY ED-G	12. MANUFACTURER'S DESIGNATION OF DRILL Truco
4. HOLE NO. (As shown on drawing title and file number) DA-3C	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED: — UNDISTURBED:
5. NAME OF DRILLER Wickersham/Hotchkiss	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED Horizontal DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED 29 Jan 91 — COMPLETED 29 Jan 91
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 1.80'	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) e
	0.25 0.5	0.63	Concrete in newer wall is as described in Core #DA-1C. No reinforcing encountered. Some mechanical bond between newer wall and older wall. Newer wall. Broken to retrieve core.	Compressive Strength = 6,282 p.s.i. S.S.D. Unit Weight = 152.0 lbs/cu. ft. Pulse Velocity = 6,379 f.p.s.
	0.75 1.0 1.25 1.5 1.75	1.80	Older wall. Surface of older wall is slightly weathered. Concrete in older wall is as described in Core # DA-1C except maximum size of coarse aggregate is 3/4". No reinforcing encountered. Broken to retrieve core.	Compressive Strength = 4,101 p.s.i. S.S.D. Unit Weight = 143.4 lbs/cu. ft. Pulse Velocity = 4,753 f.p.s.
	2.0		Shear is mostly through coarse aggregate.	


A-1C
DA-2C
DA-3C

STRUCTURAL DESIGN ANALYSIS

A
P
P
E
N
D
I
X

D

DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM NO. 8
WITH ENVIRONMENTAL ASSESSMENT

DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER

DES MOINES, IOWA

APPENDIX D
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DES MOINES, IOWA

APPENDIX D
STRUCTURAL DESIGN ANALYSIS

1. INTRODUCTION

This appendix is intended to describe the methods used in designing the structures required in this project. Supporting information is included such as design criteria, basic data and assumptions, loading conditions, and typical design computations. Sufficient design computations have been performed to establish accurate cost information. Additional computations will be performed during the preparation of plans and specifications.

2. DESIGN CRITERIA

a. References

(1) EM 1110-2-2906, Design of Pile Foundations, 15 January 1991.

(2) EM 1110-2-2502, Retaining and Flood Walls, 29 September 1989.

(3) ETL 1110-2-312, Strength Design for Reinforced Concrete Hydraulic Structures, 10 March 1988.

(4) ACI 318-89, Building Code Requirements for Reinforced Concrete.

(5) ASCE 7-88, Minimum Loads for Buildings and Other Structures, July 1990.

(6) Aluminum Construction Manual - Specifications for Aluminum Structures and Engineering Data for Aluminum Structures, December 1986.

(7) EM 1110-2-1612, Ice Engineering, 15 October 1982.

b. Reinforced Concrete Structures

Reinforced concrete structures will be designed by Ultimate Strength Design (USD) in accordance with ETL 1110-2-312. ASTM A615, grade 60 reinforcing steel and 4,000 psi (28-day strength) concrete were used in the design.

c. Steel Sheet Piling

Steel for sheet piling will conform to the requirements of ASTM A328.

d. Structural Aluminum

Structural Aluminum will conform to the requirements of ASTM B429.

3. DESIGN OF STRUCTURES

a. Background

Five structures were designed for this project: an aluminum arch with a foundation, retaining walls to be used along Locust and Walnut Streets, a planter which will serve as a floodwall, the theater stage, and the extended riverwalk.

b. Arch

The arch was analyzed as a space frame using STAAD III and the model used included the concrete columns supporting the arch. It was found that no expansion type bearings would be needed to relieve any force due to thermal expansion. The concrete piers provided some ability to translate horizontally and the shape of the arch allowed it to deflect vertically without subjecting any member to high stresses. The arch has been designed to support items associated with concerts and plays such as lights and backdrops. Because the backdrops could be tied to the arch, the most significant load on the arch is the wind load which was determined from ASCE 7-88. Four independent load cases were considered in the design: 1) dead load (DL) of the arch, 2) wind load (WL) using a basic wind speed of 80 MPH, 3) live load (LL) using 2000 pounds at each internal connection, and 4) temperature load (TEMP) of 100 degrees temperature increase. Four load combinations were also run which include: 5) DL + LL + WL + TEMP, 6) DL + WL + LL - TEMP, 7) DL + LL + TEMP, and 8) DL + LL - TEMP. The Stresses were computed and compared with allowable stresses in accordance with the Aluminum Construction Manual.

The reactions computed by STAAD III were used in the design of the arch foundation. To minimize additional load being placed on the existing riverwall and sewer, a deep foundation was used for the arch. The use of a spread footing foundation was not considered because it could subject the existing riverwall and sewer to additional

lateral load. The foundation will consist of pipe piles driven to bedrock approximately 35 feet below the foundation. The foundation is subject to loads from any direction and therefore must have adequate strength about any axis. For this reason, pipe piles were used. The foundation was analyzed with the aid of the Corps computer program CPGA (X0080).

c. Retaining Walls

The retaining walls were designed using EM 1110-2-2502 and ASCE 7-88. Their purpose is to support the sidewalk load and the portion of the vehicular traffic along locust and walnut street which affects the active soil wedge. Because of the sloping of the backfill, the most severe location was used for design and applied to the rest of the wall.

d. Floodwall/Planter Box

The floodwall/planter box serves as both a floodwall and a planter box in the freeboard area. It was analyzed using the extreme flood condition as described in EM 1110-2-2502. Since this wall only resists water in the freeboard zone the design flood condition was not considered.

e. Stage

The stage was designed to span over the existing riverwall and sewer and not place any load on these structures. ASCE 7-88 was used to determine the applicable loads and the concrete sections were designed using ETL 1110-2-312. The Corps computer program CFRAME was used to compute the shear and moment forces in the concrete beams supporting the slab. A deep foundation was used to support the stage to minimize the impact on the existing riverwall and sewer.

f. Extended Riverwalk

The proposed riverwalk consists of a concrete slab supported by concrete beams on piles. Two load cases were considered: 1) an ice load of 5 kips/ft of width plus dead load and 2) a live load of 150 psf plus dead load. The foundation of the riverwalk was analyzed with the aid of the Corps computer program CPGA (X0080).

Subject	Date
Des Moines Amphitheater	Jan 92

Computed by	Checked by	Sheet	of
TJW	BMA	1	6

ANALYSIS OF THE ARCH

The arch was analyzed using STAAD-III.

4 Load Cases were Analyzed.

1) Dead Wt

2) Wind Load - Basic wind speed of 80 MPH was used. It was assumed that the arch would be fill in completely. Therefore the area used to compute forces was a semicircle with a radius the same as the outer most chord of the arch.

3. Live load - 2000# load was hung from each interior connection.

4) Temperature Change of 100° F

5) DL + WL + LL + Temp

6) [illegible] - [illegible] - [illegible] - Temp

DL + LL + TEMP

8) DL - LL - TEMP

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1 Aug 80

Subject: Des Moine Amphitheater		Date: Jan 92
Computed by: TJW	Checked by: BMA	Sheet 2 of

LOADS

Wind Forces — Back Drop of Arch Completely filled in

Ref: Minimum Load for Building and other structures ASCE

Design as solid Sign

$A_f = \frac{\pi}{2}(29')^2 = 1321$ s.f.

$Force = q_z G_H C_f A_f$

$q_z = 0.00256\, k_z (IV)^2$

$I = 1.0$ (TABE 5)

$V = 80$ mph Figure 1

$K_z = 1.06$ (exp. C) Table 6

$q_z = 0.00256(1.06)(1 * 80)^2 = 17.37$ psf

$G_H = 1.23$ (Exposure C Table 8)

$M/N = \frac{58}{29} = 2 \Rightarrow C_f = 1.2$

Force = (17.37 psf)(1.23)(1.2)(1321 sf.) = 33868 #

Divide This load among joints 3, 5, 7, 9, 11

Force/Joint = 33868/5 = 6774 # use 6.8 K

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1 Aug 80

Subject Des Moines Amphitheater	Date Jan 92
Computed by TJW / Checked by BMA	Sheet 3 of 6

LIVE LOAD - Apply 2000# live load at all joints except for supports

Joint load @ 3	2000#
5	2000#
7	2000#
9	2000#
11	2000#
21	2000#
23	2000#
25	2000#
27	2000#
29	2000#
31	2000#
43	2000#
45	2000#
47	2000#
49	2000#
51	2000#

Dead load - Weight of structure - USE STAAD III TO COMPUTE DEAD LOAD

Temp load = $\Delta T = 100\,^\circ F$

Coef of Therm. Exp = 0.0000122 / °F

NCR Form 1 Aug 80 381b

Plate D-3

Subject: Des Moines Amphitheater		Date: Jan 92
Computed by: TJW	Checked by: BMA	Sheet 4 of 6

Check Stress in Arch

REF - SPEC. FOR ALUMINUM STRUCTURES

USE COMBINED LOAD FOR STRESS Analysis.

All member are 12" ϕ pipe w/ .25" walls
Material 6061-T6 Alum. Pipe

$E = 10100$ ksi (compressive Mod. Elast.)

$F_{tu} = 42$ ksi
$F_{ty} = 35$ ksi
$F_{cy} = 35$ ksi
$F_{su} = 27$ ksi
$F_{sy} = 20$ ksi

$A = 9.23\ in^2$
$I = 159.33\ in^4$
$S = 26.56\ in^3$
$r = 4.16\ in$

Determine Allowable STRESS (Table 3.3.27 Spec. for Alum Struct.)

$L/r = 142"/4.16 = 34.0$

$L/r > S_1 = 9.5 \qquad L/r < S_2 = 66$

Spec 7 Allowable compression (columns) $= 20.2 - 0.126(34.0) = 15.92$ k

Spec 10 $R/t = (11.5/2)/.25 = 23 \qquad F_c = 13.5 - 0.5\sqrt{23} = 11.1$ k gov.

Subject: Des Moines Amphitheater		Date: Jan 92
Computed by: TJW	Checked by: BMA	Sheet 5 of 6

USE Allowable Compression = 11.1 ksi

Check Bending

F_{br} = 29 ksi (18 ksi with 1" of weld) Tension

F_c = 14.24 (Same as spec 10)

FROM STAAD III OUT PUT

Max Combined Stress occurs in Member 42 @ Connect.

Combined Stress = 14.7 ksi Load Case 6

Since it is within 1" of a weld

F_c = 11.1 ksi

Since 14.7 is the result of a wind load allow a 1/3 increase for temporary load

$F_c = 11.1\,(4/3) = 14.8$ ksi

OK

(since 11.1 < 14.24, using it as the allowable stress and the combined stress as the actual stress is conservative)

NCR Form 1 Aug 80 381b

Subject Des Moines Amphitheater		Date July 92
Computed by TJW	Checked by BMA	Sheet 6 of 6

Load Cases 1, 3, 4, 7, + 8
No overstressing is allowed

For these Load Cases

The Max Stress = 8.5 ksi
(Member 26, Load Case 7)

8.5 < 11.1 ksi

OK

```
****************************************************
*                                                  *
*          S T A A D - III                         *
*          REVISION 15.0 (VERSION 15 LEVEL 0)      *
*          PROPRIETARY PROGRAM OF                  *
*          RESEARCH ENGINEERS,INC.                 *
*          DATE=    JUL 31, 1992                   *
*          TIME=    10:53:48                       *
*                                                  *
****************************************************
```

```
 1. STAAD SPACE  AMPHITHEATER ARCH
 2. UNIT KIP FEE
 3. INPUT WIDTH 79
 4. OUTPUT WIDTH 72
 5. PAGE ..NGTH 60
 6. JOINT COORDINATES CYLINDRICAL
 7.    1     29.000      0.000      0.000
 8.    2     29.000     15.000      0.000
 9.    3     29.000     30.000      0.000
10.    4     29.000     45.000      0.000
11.    5     29.000     60.000      0.000
12.    6     29.000     75.000      0.000
13.    7     29.000     90.000      0.000
14.    8     29.000    105.000      0.000
15.    9     29.000    120.000      0.000
16.   10     29.000    135.000      0.000
17.   11     29.000    150.000      0.000
18.   12     29.000    165.000      0.000
19.   13     29.000    180.000      0.000
20.   21     19.0      15.000    4.5
21.   22     19.0      30.000    4.5
22.   23     19.0      45.000    4.5
23.   24     19.0      60.000    4.5
24.   25     19.0      75.000    4.5
25.   26     19.0      90.000    4.5
26.   27     19.0     105.000    4.5
27.   28     19.0     120.000    4.5
28.   29     19.0     135.000    4.5
29.   30     19.0     150.000    4.5
30.   31     19.0     165.000    4.5
31.   41     29.0       0.000    9.0
32.   42     29.0      15.000    9.0
33.   43     29.0      30.000    9.0
34.   44     29.0      45.000    9.0
35.   45     29.0      60.000    9.0
36.   46     29.0      75.000    9.0
37.   47     29.0      90.000    9.0
38.   48     29.0     105.000    9.0
39.   49     29.0     120.000    9.0
40.   50     29.0     135.000    9.0
41.   51     29.0     150.000    9.0
42.   52     29.0     165.000    9.0
```

Plate D-7

```
53        29.0       180.000       9.0
JOINT COORDINATES
101       29 -11 0
113       -29 -11 0
141       29 -11 9
153       -29 -11 9
MEMBER INCIDENCES
1     1     2
2     2     3
3     3     4
4     4     5
5     5     6
6     6     7
7     7     8
8     8     9
9     9     10
10    10    11
11    11    12
12    12    13
21    21    22
22    22    23
23    23    24
24    24    25
25    25    26
26    26    27
27    27    28
28    28    29
29    29    30
30    30    31
41    41    42
42    42    43
43    43    44
44    44    45
45    45    46
46    46    47
47    47    48
48    48    49
49    49    50
50    50    51
51    51    52
52    52    53
101   3     43
102   5     45
103   7     47
104   9     49
105   11    51
120   1     21
121   21    3
122   3     23
123   23    5
124   5     25
125   25    7
126   7     27
127   27    9
128   9     29
129   29    11
130   11    31
```

```
100.   131   31   13
101.   140   41   21
102.   141   21   43
103.   142   43   23
104.   143   23   45
105.   144   45   25
106.   145   25   47
107.   146   47   27
108.   147   27   49
109.   148   49   29
110.   149   29   51
111.   150   51   31
112.   151   31   53
113.   201 101 1
114.   202 113 13
115.   203 141 41
116.   204 153 53
117. SUPPORT
118. 101 113 141 153 FIXED
119. UNITS IN
120. CONSTANTS
121. E 10000 1 TO 12 21 TO 30 41 TO 52 101 TO 105 120 TO 131 140 TO 151
122. E 3600 201 TO 204
123. POISSON .33 1 TO 12 21 TO 30 41 TO 52 101 TO 105 120 TO 131 140 TO 151
124. POISSON .15 201 TO 204
125. ALPHA .0000128 1 TO 12 21 TO 30 41 TO 52 101 TO 105 120 TO 131 140 TO 151
126. ALPHA .0000055 201 TO 204
127. UNITS FT
128. DENSITY .165 1 TO 12 21 TO 30 41 TO 52 101 TO 105 120 TO 131 140 TO 151
129. DENSITY .150 201 TO 204
130. UNITS IN
131. MEMBER PROP
132. 1 TO 12 TA ST PIPE OD 12 ID 11.5
133. 21 TO 30 TA ST PIPE OD 12 ID 11.5
134. 41 TO 52 TA ST PIPE OD 12 ID 11.5
135. 101 TO 105 TA ST PIPE OD 12 ID 11.5
136. 120 TO 131 TA ST PIPE OD 12 ID 11.5
137. 140 TO 151 TA ST PIPE OD 12 ID 11.5
138. 201 TO 204 PRIS YD 24 ZD 24
139. LOADING 1 DEAD LOAD
140. SELFWEIGHT
141. LOADING 2 WIND LOAD
142. JOINT LOADS
143. 2 TO 12 FZ 3.080
144. LOADING 3 LIVE LOAD
145. JOINT LOADS
146. 3 5 7 9 11 21 23 25 27 29 31 43 45 47 49 51 FY -2
147. LOADING 4 TEMPERATURE
148. TEMP LOAD
149. 1 TO 12 21 TO 30 41 TO 52 101 TO 105 120 TO 131 140 TO 151 TEMP 100
150. 201 TO 204 TEMP 100
151. LOAD COMBINATION 5 DEAD+WIND+LIVE+TEMP
152. 1 1 2 1 3 1 4 1
153. LOAD COMBINATION 6 DEAD+WIND+LIVE-TEMP
154. 1 1 2 1 3 1 4 -1
155. LOAD COMBINATION 7 DEAD+LIVE+TEMP
156. 1 1 3 1 4 1
```

Plate D9

157. LOAD COMBINATION 8 DEAD+LIVE-TEMP
158. 1 1 3 1 4 -1
159. PERFORM ANALYSIS

P R O B L E M   S T A T I S T I C S

NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS = 41/ 67/ 4
ORIGINAL/FINAL BAND-WIDTH = 37/ 6
TOTAL PRIMARY LOAD CASES = 4, TOTAL DEGREES OF FREEDOM = 222
SIZE OF STIFFNESS MATRIX = 7992 DOUBLE PREC. WORDS
TOTAL REQUIRED DISK SPACE = 12.25 MEGA-BYTES

++ PROCESSING ELEMENT STIFFNESS MATRIX. 10:53:49
++ PROCESSING GLOBAL STIFFNESS MATRIX. 10:53:50
++ PROCESSING TRIANGULAR FACTORIZATION. 10:53:50
++ CALCULATING JOINT DISPLACEMENTS. 10:53:51
++ CALCULATING ELEMENT FORCES. 10:53:51

160. PRINT MEMBER PROPERTIES ALL

MEMBER PROPERTIES. UNIT - INCH

MEMB	PROFILE	AX/ AY	IZ/ AZ	IY/ SZ	IX/ SY
1	ST PIPE	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
2	ST PIPE	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
3	ST PIPE	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
4	ST PIPE	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
5	ST PIPE	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
6	ST PIPE	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
7	ST PIPE	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
8	ST PIPE	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
9	ST PIPE	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
10	ST PIPE	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
11	ST PIPE	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
12	ST PIPE	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
21	ST PIPE	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
22	ST PIPE	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56

23	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
24	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
25	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
26	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
27	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
28	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
29	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
30	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56

MEMBER PROPERTIES. UNIT - INCH

MEMB	PROFILE	AX/ AY	IZ/ AZ	IY/ SZ	IX/ SY
41	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
42	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
43	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
44	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
45	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
46	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
47	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
48	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
49	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
50	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
51	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
52	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
101	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
102	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
103	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
104	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
105	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56

120	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
121	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
122	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
123	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
124	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56

MEMBER PROPERTIES. UNIT - INCH

MEMB	PROFILE	AX/ AY	IZ/ AZ	IY/ SZ	IX/ SY
125	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
126	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
127	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
128	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
129	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
130	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
131	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
140	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
141	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
142	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
143	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
144	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
145	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
146	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
147	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
148	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
149	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
150	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
151	ST PIP E	9.23	159.33	159.33	318.52
		5.54	5.54	26.56	26.56
201	PRISMATIC	576.00	27648.00	27648.00	40554.09
		576.00	576.00	2304.00	2304.00

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202	PRISMATIC	576.00	27648.00	27648.00	40554.09
		576.00	576.00	2304.00	2304.00
203	PRISMATIC	576.00	27648.00	27648.00	40554.09
		576.00	576.00	2304.00	2304.00

MEMBER PROPERTIES. UNIT - INCH

MEMB	PROFILE	AX/ AY	IZ/ AZ	IY/ SZ	IX/ SY
204	PRISMATIC	576.00	27648.00	27648.00	40554.09
		576.00	576.00	2304.00	2304.00

************ END OF DATA FROM INTERNAL STORAGE ************

161. PRINT MATERIAL PROPERTIES

MATERIAL PROPERTIES.

ALL UNITS ARE - KIP IN

MEMBER	E	G	DEN	ALPHA
1	10000.0	3759.4	0.00009549	0.00001280
2	10000.0	3759.4	0.00009549	0.00001280
3	10000.0	3759.4	0.00009549	0.00001280
4	10000.0	3759.4	0.00009549	0.00001280
5	10000.0	3759.4	0.00009549	0.00001280
6	10000.0	3759.4	0.00009549	0.00001280
7	10000.0	3759.4	0.00009549	0.00001280
8	10000.0	3759.4	0.00009549	0.00001280
9	10000.0	3759.4	0.00009549	0.00001280
10	10000.0	3759.4	0.00009549	0.00001280
11	10000.0	3759.4	0.00009549	0.00001280
12	10000.0	3759.4	0.00009549	0.00001280
21	10000.0	3759.4	0.00009549	0.00001280
22	10000.0	3759.4	0.00009549	0.00001280
23	10000.0	3759.4	0.00009549	0.00001280
24	10000.0	3759.4	0.00009549	0.00001280
25	10000.0	3759.4	0.00009549	0.00001280
26	10000.0	3759.4	0.00009549	0.00001280
27	10000.0	3759.4	0.00009549	0.00001280
28	10000.0	3759.4	0.00009549	0.00001280
29	10000.0	3759.4	0.00009549	0.00001280
30	10000.0	3759.4	0.00009549	0.00001280
41	10000.0	3759.4	0.00009549	0.00001280
42	10000.0	3759.4	0.00009549	0.00001280
43	10000.0	3759.4	0.00009549	0.00001280
44	10000.0	3759.4	0.00009549	0.00001280
45	10000.0	3759.4	0.00009549	0.00001280
46	10000.0	3759.4	0.00009549	0.00001280
47	10000.0	3759.4	0.00009549	0.00001280
48	10000.0	3759.4	0.00009549	0.00001280

49	10000.0	3759.4	0.00009549	0.00001280
50	10000.0	3759.4	0.00009549	0.00001280
51	10000.0	3759.4	0.00009549	0.00001280
52	10000.0	3759.4	0.00009549	0.00001280
101	10000.0	3759.4	0.00009549	0.00001280
102	10000.0	3759.4	0.00009549	0.00001280
103	10000.0	3759.4	0.00009549	0.00001280
104	10000.0	3759.4	0.00009549	0.00001280
105	10000.0	3759.4	0.00009549	0.00001280
120	10000.0	3759.4	0.00009549	0.00001280
121	10000.0	3759.4	0.00009549	0.00001280
122	10000.0	3759.4	0.00009549	0.00001280

MATERIAL PROPERTIES.

ALL UNITS ARE - KIP IN

MEMBER	E	G	DEN	ALPHA
123	10000.0	3759.4	0.00009549	0.00001280
124	10000.0	3759.4	0.00009549	0.00001280
125	10000.0	3759.4	0.00009549	0.00001280
126	10000.0	3759.4	0.00009549	0.00001280
127	10000.0	3759.4	0.00009549	0.00001280
128	10000.0	3759.4	0.00009549	0.00001280
129	10000.0	3759.4	0.00009549	0.00001280
130	10000.0	3759.4	0.00009549	0.00001280
131	10000.0	3759.4	0.00009549	0.00001280
140	10000.0	3759.4	0.00009549	0.00001280
141	10000.0	3759.4	0.00009549	0.00001280
142	10000.0	3759.4	0.00009549	0.00001280
143	10000.0	3759.4	0.00009549	0.00001280
144	10000.0	3759.4	0.00009549	0.00001280
145	10000.0	3759.4	0.00009549	0.00001280
146	10000.0	3759.4	0.00009549	0.00001280
147	10000.0	3759.4	0.00009549	0.00001280
148	10000.0	3759.4	0.00009549	0.00001280
149	10000.0	3759.4	0.00009549	0.00001280
150	10000.0	3759.4	0.00009549	0.00001280
151	10000.0	3759.4	0.00009549	0.00001280
201	3600.0	1565.2	0.00008681	0.00000550
202	3600.0	1565.2	0.00008681	0.00000550
203	3600.0	1565.2	0.00008681	0.00000550
204	3600.0	1565.2	0.00008681	0.00000550

************ END OF DATA FROM INTERNAL STORAGE ************

162. PRINT JOIN COORDINATES

JOINT COORDINATES

COORDINATES ARE IN UNIT

JOINT	X	Y	Z
1	348.000	0.000	0.000
2	336.142	90.069	0.000
3	301.376	174.000	0.000
4	246.073	246.073	0.000
5	174.000	301.376	0.000
6	90.069	336.143	0.000
7	0.000	348.000	0.000
8	-90.069	336.142	0.000
9	-174.000	301.376	0.000
10	-246.073	246.073	0.000
11	-301.378	174.000	0.000
12	-336.143	90.069	0.000
13	-348.000	0.000	0.000
21	220.231	59.011	54.000
22	197.454	114.000	54.000
23	161.220	161.220	54.000
24	114.000	197.454	54.000
25	59.011	220.231	54.000
26	0.000	228.000	54.000
27	-59.011	220.231	54.000
28	-114.000	197.454	54.000
29	-161.220	161.220	54.000
30	-197.454	114.000	54.000
31	-220.231	59.011	54.000
41	348.000	0.000	108.000
42	336.142	90.069	108.000
43	301.376	174.000	108.000
44	246.073	246.073	108.000
45	174.000	301.376	108.000
46	90.069	336.143	108.000
47	0.000	348.000	108.000
48	-90.069	336.142	108.000
49	-174.000	301.376	108.000
50	-246.073	246.073	108.000
51	-301.378	174.000	108.000
52	-336.143	90.069	108.000
53	-348.000	0.000	108.000
101	348.000	-132.000	0.000
113	-348.000	-132.000	0.000
141	348.000	-132.000	108.000
153	-348.000	-132.000	108.000

************ END OF DATA FROM INTERNAL STORAGE ************

163. PRINT MEMBER STRESS

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
1	1	.0	0.1 C	0.0	0.2	0.3	0.0	0.0
		1.00	0.1 C	0.0	0.3	0.4	0.0	0.0
	2	.0	3.1 T	4.1	4.6	9.2	0.6	0.3
		1.00	3.1 T	1.5	7.5	10.7	0.6	0.3
	3	.0	0.7 C	0.2	0.9	1.6	0.1	0.0
		1.00	0.7 C	0.0	1.7	2.5	0.1	0.0
	4	.0	0.3 T	0.1	0.8	1.1	0.0	0.0
		1.00	0.3 T	0.1	0.8	1.1	0.0	0.0
	5	.0	2.5 T	4.1	2.8	7.5	0.5	0.3
		1.00	2.5 T	1.4	6.3	9.0	0.5	0.3
	6	.0	1.9 T	4.4	4.4	8.1	0.5	0.3
		1.00	1.9 T	1.5	4.7	6.8	0.5	0.3
	7	.0	0.6 C	0.1	1.9	2.4	0.2	0.0
		1.00	0.5 C	0.1	1.2	1.7	0.2	0.0
	8	.0	1.2 C	0.3	0.2	1.5	0.2	0.0
		1.00	1.2 C	0.0	2.9	4.0	0.2	0.0
2	1	.0	0.1 C	0.0	0.3	0.4	0.0	0.0
		1.00	0.1 C	0.0	0.2	0.3	0.0	0.0
	2	.0	3.1 T	1.3	7.5	10.7	0.7	0.3
		1.00	3.1 T	3.7	5.7	9.9	0.7	0.3
	3	.0	0.7 C	0.0	1.7	2.5	0.2	0.0
		1.00	0.7 C	0.1	1.7	2.4	0.2	0.0
	4	.0	0.3 T	0.1	0.8	1.1	0.1	0.0
		1.00	0.3 T	0.3	1.6	1.9	0.1	0.0
	5	.0	2.5 T	1.2	6.3	8.9	0.6	0.3
		1.00	2.5 T	3.8	5.4	9.2	0.6	0.3
	6	.0	1.9 T	1.3	4.7	6.8	0.4	0.2
		1.00	1.9 T	3.3	2.2	5.9	0.4	0.2
	7	.0	0.6 C	0.1	1.2	1.7	0.1	0.0
		1.00	0.5 C	0.1	0.3	0.9	0.1	0.0
	8	.0	1.1 C	0.0	2.9	4.0	0.3	0.0
		1.00	1.1 C	0.4	3.5	4.6	0.3	0.0
3	1	.0	0.1 C	0.0	0.2	0.3	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0
	2	.0	1.5 T	7.6	2.8	9.6	0.3	0.5
		1.00	1.5 T	2.0	3.1	5.2	0.3	0.5
	3	.0	0.5 C	0.0	1.2	1.6	0.1	0.0
		1.00	0.5 C	0.0	0.9	1.3	0.1	0.0
	4	.0	0.9 T	0.0	1.6	2.5	0.2	0.0
		1.00	0.9 T	0.0	1.7	2.5	0.2	0.0
	5	.0	1.8 T	7.6	3.0	10.0	0.4	0.5
		1.00	1.9 T	2.0	3.7	6.1	0.4	0.5
	6	.0	0.1 T	7.5	0.1	7.6	0.0	0.5
		1.00	0.1 T	2.0	0.4	2.2	0.0	0.5

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MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	7	.0	0.3 T	0.0	0.2	0.6	0.1	0.0
		1.00	0.3 T	0.0	0.6	1.0	0.0	0.0
	8	.0	1.4 C	0.0	2.9	4.4	0.3	0.0
		1.00	1.4 C	0.0	2.7	4.1	0.3	0.0
4	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.1	0.0	0.0
	2	.0	1.5 T	2.3	3.1	5.3	0.3	0.0
		1.00	1.5 T	1.3	3.5	5.3	0.3	0.0
	3	.0	0.5 C	0.0	0.9	1.4	0.1	0.0
		1.00	0.5 C	0.0	0.9	1.4	0.1	0.0
	4	.0	0.9 T	0.0	1.7	2.5	0.2	0.0
		1.00	0.9 T	0.0	2.5	3.4	0.2	0.0
	5	.0	1.8 T	2.3	3.7	6.2	0.5	0.0
		1.00	1.8 T	1.3	5.1	7.1	0.5	0.0
	6	.0	0.1 T	2.3	0.4	2.4	0.0	0.1
		1.00	0.1 T	1.3	0.1	1.4	0.0	0.1
	7	.0	0.3 T	0.0	0.6	1.0	0.1	0.0
		1.00	0.3 T	0.0	1.5	1.9	0.1	0.0
	8	.0	1.4 C	0.0	2.7	4.1	0.3	0.0
		1.00	1.4 C	0.0	3.5	4.9	0.3	0.0
5	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0
	2	.0	0.6 T	4.2	1.4	5.1	0.1	0.4
		1.00	0.6 T	3.0	0.8	3.8	0.1	0.4
	3	.0	0.4 C	0.0	0.9	1.3	0.1	0.0
		1.00	0.4 C	0.0	0.8	1.2	0.1	0.0
	4	.0	1.2 T	0.0	2.6	3.8	0.3	0.0
		1.00	1.2 T	0.0	2.3	3.5	0.3	0.0
	5	.0	1.4 T	4.2	3.0	6.6	0.3	0.4
		1.00	1.4 T	3.0	2.2	5.1	0.3	0.4
	6	.0	1.1 C	4.3	2.2	5.9	0.2	0.4
		1.00	1.1 C	3.0	2.4	4.9	0.2	0.4
	7	.0	0.7 T	0.0	1.6	2.4	0.2	0.0
		1.00	0.7 T	0.0	1.4	2.1	0.2	0.0
	8	.0	1.7 C	0.0	3.6	5.3	0.4	0.0
		1.00	1.7 C	0.0	3.2	5.0	0.4	0.0
6	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.1	0.0	0.0
	2	.0	0.6 T	3.1	0.8	3.9	0.2	0.2
		1.00	0.6 T	0.1	2.1	2.7	0.2	0.2
	3	.0	0.4 C	0.0	0.8	1.2	0.1	0.0
		1.00	0.4 C	0.0	0.9	1.3	0.1	0.0
	4	.0	1.2 T	0.0	2.3	3.5	0.3	0.0
		1.00	1.2 T	0.0	3.0	4.2	0.3	0.0

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	5	.0	1.4 T	3.2	2.2	5.2	0.3	0.2
		1.00	1.4 T	0.1	4.1	5.4	0.3	0.2
	6	.0	1.1 C	3.1	2.4	5.0	0.2	0.2
		1.00	1.1 C	0.1	1.9	3.0	0.2	0.2
	7	.0	0.7 T	0.0	1.4	2.1	0.2	0.0
		1.00	0.7 T	0.0	2.0	2.7	0.2	0.0
	8	.0	1.7 C	0.0	3.2	5.0	0.4	0.0
		1.00	1.7 C	0.0	4.0	5.7	0.4	0.0
7	1	.0	0.1 C	0.0	0.1	0.1	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0
	2	.0	0.6 T	0.1	2.1	2.7	0.2	0.2
		1.00	0.6 T	3.1	0.8	3.9	0.2	0.2
	3	.0	0.4 C	0.0	0.9	1.3	0.1	0.0
		1.00	0.4 C	0.0	0.8	1.2	0.1	0.0
	4	.0	1.2 T	0.0	3.0	4.2	0.3	0.0
		1.00	1.2 T	0.0	2.3	3.5	0.3	0.0
	5	.0	1.4 T	0.1	4.1	5.4	0.3	0.2
		1.00	1.4 T	3.2	2.2	5.2	0.3	0.2
	6	.0	1.1 C	0.1	1.9	3.0	0.2	0.2
		1.00	1.1 C	3.1	2.4	5.0	0.2	0.2
	7	.0	0.7 T	0.0	2.0	2.7	0.2	0.0
		1.00	0.7 T	0.0	1.4	2.1	0.2	0.0
	8	.0	1.7 C	0.0	4.0	5.7	0.4	0.0
		1.00	1.7 C	0.0	3.2	5.0	0.4	0.0
8	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0
	2	.0	0.6 T	3.0	0.8	3.8	0.1	0.4
		1.00	0.6 T	4.2	1.4	5.1	0.1	0.4
	3	.0	0.4 C	0.0	0.8	1.2	0.1	0.0
		1.00	0.4 C	0.0	0.9	1.3	0.1	0.0
	4	.0	1.2 T	0.0	2.3	3.5	0.3	0.0
		1.00	1.2 T	0.0	2.6	3.8	0.3	0.0
	5	.0	1.4 T	3.0	2.2	5.1	0.3	0.4
		1.00	1.4 T	4.2	3.0	6.6	0.3	0.4
	6	.0	1.1 C	3.0	2.4	4.9	0.2	0.4
		1.00	1.1 C	4.3	2.2	5.9	0.2	0.4
	7	.0	0.7 T	0.0	1.4	2.1	0.2	0.0
		1.00	0.7 T	0.0	1.6	2.4	0.2	0.0
	8	.0	1.7 C	0.0	3.2	5.0	0.4	0.0
		1.00	1.7 C	0.0	3.6	5.3	0.4	0.0
9	1	.0	0.1 C	0.0	0.1	0.1	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0
	2	.0	1.5 T	1.3	3.5	5.3	0.3	0.0
		1.00	1.5 T	2.3	3.1	5.3	0.3	0.0

Plate D-12

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	3	.0	0.5 C	0.0	0.9	1.4	0.1	0.0
		1.00	0.5 C	0.0	0.9	1.4	0.1	0.0
	4	.0	0.9 T	0.0	2.5	3.4	0.2	0.0
		1.00	0.9 T	0.0	1.7	2.5	0.2	0.0
	5	.0	1.8 T	1.3	5.1	7.1	0.5	0.0
		1.00	1.8 T	2.3	3.7	6.2	0.5	0.0
	6	.0	0.1 T	1.3	0.1	1.4	0.0	0.1
		1.00	0.1 T	2.3	0.4	2.4	0.0	0.1
	7	.0	0.3 T	0.0	1.5	1.9	0.1	0.0
		1.00	0.3 T	0.0	0.6	1.0	0.1	0.0
	8	.0	1.4 C	0.0	3.5	4.9	0.3	0.0
		1.00	1.4 C	0.0	2.7	4.1	0.3	0.0
10	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.2	0.3	0.0	0.0
	2	.0	1.5 T	2.0	3.1	5.2	0.3	0.5
		1.00	1.5 T	7.6	2.8	9.6	0.3	0.5
	3	.0	0.5 C	0.0	0.9	1.3	0.1	0.0
		1.00	0.5 C	0.0	1.2	1.6	0.1	0.0
	4	.0	0.9 T	0.0	1.7	2.5	0.2	0.0
		1.00	0.9 T	0.0	1.6	2.5	0.2	0.0
	5	.0	1.9 T	2.0	3.7	6.1	0.4	0.5
		1.00	1.8 T	7.6	3.0	10.0	0.4	0.5
	6	.0	0.1 T	2.0	0.4	2.2	0.0	0.5
		1.00	0.1 T	7.5	0.1	7.6	0.0	0.5
	7	.0	0.3 T	0.0	0.6	1.0	0.0	0.0
		1.00	0.3 T	0.0	0.2	0.6	0.1	0.0
	8	.0	1.4 C	0.0	2.7	4.1	0.3	0.0
		1.00	1.4 C	0.0	2.9	4.4	0.3	0.0
11	1	.0	0.1 C	0.0	0.2	0.3	0.0	0.0
		1.00	0.1 C	0.0	0.3	0.4	0.0	0.0
	2	.0	3.1 T	3.7	5.7	9.9	0.7	0.3
		1.00	3.1 T	1.3	7.5	10.7	0.7	0.3
	3	.0	0.7 C	0.1	1.7	2.4	0.2	0.0
		1.00	0.7 C	0.0	1.7	2.5	0.2	0.0
	4	.0	0.3 T	0.3	1.6	1.9	0.1	0.0
		1.00	0.3 T	0.1	0.8	1.1	0.1	0.0
	5	.0	2.5 T	3.8	5.4	9.2	0.6	0.3
		1.00	2.5 T	1.2	6.3	8.9	0.6	0.3
	6	.0	1.9 T	3.3	2.2	5.9	0.4	0.2
		1.00	1.9 T	1.3	4.7	6.8	0.4	0.2
	7	.0	0.5 C	0.1	0.3	0.9	0.1	0.0
		1.00	0.6 C	0.1	1.2	1.7	0.1	0.0
	8	.0	1.1 C	0.4	3.5	4.6	0.3	0.0
		1.00	1.1 C	0.0	2.9	4.0	0.3	0.0
12	1	.0	0.1 C	0.0	0.3	0.4	0.0	0.0
		1.00	0.1 C	0.0	0.2	0.3	0.0	0.0

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	2	.0	3.1 T	1.5	7.5	10.7	0.6	0.3
		1.00	3.1 T	4.1	4.6	9.2	0.6	0.3
	3	.0	0.7 C	0.0	1.7	2.5	0.1	0.0
		1.00	0.7 C	0.2	0.9	1.6	0.1	0.0
	4	.0	0.3 T	0.1	0.8	1.1	0.0	0.0
		1.00	0.3 T	0.1	0.8	1.1	0.0	0.0
	5	.0	2.5 T	1.4	6.3	9.0	0.5	0.3
		1.00	2.5 T	4.1	2.8	7.5	0.5	0.3
	6	.0	1.9 T	1.5	4.7	6.8	0.5	0.3
		1.00	1.9 T	4.4	4.4	8.1	0.5	0.3
	7	.0	0.5 C	0.1	1.2	1.7	0.2	0.0
		1.00	0.6 C	0.1	1.9	2.4	0.2	0.0
	8	.0	1.2 C	0.0	2.9	4.0	0.2	0.0
		1.00	1.2 C	0.3	0.2	1.5	0.2	0.0
21	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0
	2	.0	0.0 C	0.1	0.0	0.2	0.0	0.1
		1.00	0.0 C	1.1	0.0	1.1	0.0	0.1
	3	.0	0.5 C	0.0	0.8	1.3	0.1	0.0
		1.00	0.5 C	0.0	0.6	1.1	0.1	0.0
	4	.0	1.6 C	0.0	1.5	3.1	0.3	0.0
		1.00	1.6 C	0.0	2.5	4.2	0.3	0.0
	5	.0	2.2 C	0.1	2.4	4.7	0.5	0.1
		1.00	2.2 C	1.1	3.3	5.7	0.5	0.1
	6	.0	1.0 T	0.1	0.6	1.6	0.2	0.1
		1.00	1.0 T	1.1	1.8	3.1	0.2	0.1
	7	.0	2.2 C	0.0	2.4	4.6	0.5	0.0
		1.00	2.2 C	0.0	3.3	5.5	0.5	0.0
	8	.0	1.1 T	0.0	0.6	1.7	0.2	0.0
		1.00	1.1 T	0.0	1.8	2.9	0.2	0.0
22	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0
	2	.0	0.0 C	0.8	0.0	0.8	0.0	0.1
		1.00	0.0 C	1.7	0.0	1.7	0.0	0.1
	3	.0	0.5 C	0.0	0.6	1.1	0.1	0.0
		1.00	0.5 C	0.0	0.6	1.1	0.1	0.0
	4	.0	1.6 C	0.0	2.5	4.2	0.4	0.0
		1.00	1.6 C	0.0	2.3	3.9	0.4	0.0
	5	.0	2.2 C	0.8	3.3	5.6	0.5	0.1
		1.00	2.2 C	1.7	3.0	5.7	0.5	0.1
	6	.0	1.0 T	0.8	1.8	3.0	0.3	0.1
		1.00	1.0 T	1.7	1.6	3.3	0.3	0.1
	7	.0	2.2 C	0.0	3.3	5.5	0.5	0.0
		1.00	2.2 C	0.0	3.0	5.2	0.5	0.0
	8	.0	1.0 T	0.0	1.8	2.8	0.3	0.0
		1.00	1.1 T	0.0	1.6	2.6	0.3	0.0

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
23	1	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.1	0.0	0.0
	2	.0	0.0 C	1.9	0.0	2.0	0.0	0.1
		1.00	0.0 C	0.1	0.0	0.1	0.0	0.1
	3	.0	0.2 C	0.0	0.4	0.6	0.1	0.0
		1.00	0.2 C	0.0	0.3	0.5	0.1	0.0
	4	.0	2.9 C	0.0	3.4	6.3	0.6	0.0
		1.00	2.9 C	0.0	4.4	7.3	0.6	0.0
	5	.0	3.2 C	1.9	3.8	7.4	0.7	0.1
		1.00	3.2 C	0.1	4.8	8.0	0.7	0.1
	6	.0	2.6 T	1.9	3.0	6.2	0.6	0.1
		1.00	2.6 T	0.1	4.0	6.6	0.6	0.1
	7	.0	3.2 C	0.0	3.7	6.9	0.7	0.0
		1.00	3.2 C	0.0	4.7	7.9	0.7	0.0
	8	.0	2.6 T	0.0	3.0	5.7	0.6	0.0
		1.00	2.6 T	0.0	4.1	6.7	0.6	0.0
24	1	.0	0.0 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.1	0.0	0.0
	2	.0	0.0 C	0.5	0.0	0.5	0.0	0.1
		1.00	0.0 C	1.4	0.0	1.4	0.0	0.1
	3	.0	0.2 C	0.0	0.3	0.5	0.1	0.0
		1.00	0.2 C	0.0	0.3	0.6	0.1	0.0
	4	.0	2.9 C	0.0	4.4	7.3	0.6	0.0
		1.00	2.9 C	0.0	3.6	6.5	0.6	0.0
	5	.0	3.2 C	0.5	4.8	8.0	0.7	0.1
		1.00	3.2 C	1.4	4.1	7.5	0.7	0.1
	6	.0	2.6 T	0.5	4.0	6.7	0.6	0.1
		1.00	2.6 T	1.4	3.2	6.1	0.6	0.1
	7	.0	3.2 C	0.0	4.7	7.9	0.7	0.0
		1.00	3.2 C	0.0	4.0	7.2	0.7	0.0
	8	.0	2.6 T	0.0	4.1	6.7	0.6	0.0
		1.00	2.6 T	0.0	3.3	5.9	0.6	0.0
25	1	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	0.0 C	0.8	0.0	0.8	0.0	0.0
		1.00	0.0 C	0.8	0.1	0.8	0.0	0.0
	3	.0	0.1 C	0.0	0.2	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.0	0.0
	4	.0	3.4 C	0.0	4.0	7.4	0.7	0.0
		1.00	3.4 C	0.0	5.1	8.5	0.7	0.0
	5	.0	3.5 C	0.8	4.2	7.8	0.7	0.0
		1.00	3.5 C	0.8	5.1	8.6	0.8	0.0
	6	.0	3.3 T	0.8	3.8	7.2	0.7	0.0
		1.00	3.3 T	0.8	5.1	8.4	0.7	0.0

Plate D-21

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	7	.0	3.4 C	0.0	4.2	7.6	0.7	0.0
		1.00	3.4 C	0.0	5.1	8.5	0.8	0.0
	8	.0	3.3 T	0.0	3.9	7.2	0.7	0.0
		1.00	3.3 T	0.0	5.2	8.5	0.7	0.0
26	1	.0	0.0 T	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.0	0.0	0.0
	2	.0	0.0 C	0.8	0.1	0.8	0.0	0.0
		1.00	0.0 C	0.8	0.0	0.8	0.0	0.0
	3	.0	0.1 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.1 C	0.0	0.2	0.2	0.0	0.0
	4	.0	3.4 C	0.0	5.1	8.5	0.7	0.0
		1.00	3.4 C	0.0	4.0	7.4	0.7	0.0
	5	.0	3.5 C	0.8	5.1	8.6	0.8	0.0
		1.00	3.5 C	0.8	4.2	7.8	0.7	0.0
	6	.0	3.3 T	0.8	5.1	8.4	0.7	0.0
		1.00	3.3 T	0.8	3.8	7.2	0.7	0.0
	7	.0	3.4 C	0.0	5.1	8.5	0.8	0.0
		1.00	3.4 C	0.0	4.2	7.6	0.7	0.0
	8	.0	3.3 T	0.0	5.2	8.5	0.7	0.0
		1.00	3.3 T	0.0	3.9	7.2	0.7	0.0
27	1	.0	0.0 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.1	0.0	0.0
	2	.0	0.0 C	1.4	0.0	1.4	0.0	0.1
		1.00	0.0 C	0.5	0.0	0.5	0.0	0.1
	3	.0	0.2 C	0.0	0.3	0.6	0.1	0.0
		1.00	0.2 C	0.0	0.3	0.5	0.1	0.0
	4	.0	2.9 C	0.0	3.6	6.5	0.6	0.0
		1.00	2.9 C	0.0	4.4	7.3	0.6	0.0
	5	.0	3.2 C	1.4	4.1	7.5	0.7	0.1
		1.00	3.2 C	0.5	4.8	8.0	0.7	0.1
	6	.0	2.6 T	1.4	3.2	6.1	0.6	0.1
		1.00	2.6 T	0.5	4.0	6.7	0.6	0.1
	7	.0	3.2 C	0.0	4.0	7.2	0.7	0.0
		1.00	3.2 C	0.0	4.7	7.9	0.7	0.0
	8	.0	2.6 T	0.0	3.3	5.9	0.6	0.0
		1.00	2.6 T	0.0	4.1	6.7	0.6	0.0
28	1	.0	0.0 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	0.0 C	0.1	0.0	0.1	0.0	0.1
		1.00	0.0 C	1.9	0.0	2.0	0.0	0.1
	3	.0	0.2 C	0.0	0.3	0.5	0.1	0.0
		1.00	0.2 C	0.0	0.4	0.6	0.1	0.0
	4	.0	2.9 C	0.0	4.4	7.3	0.6	0.0
		1.00	2.9 C	0.0	3.4	6.3	0.6	0.0

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	5	.0	3.2 C	0.1	4.8	8.0	0.7	0.1
		1.00	3.2 C	1.9	3.8	7.4	0.7	0.1
	6	.0	2.6 T	0.1	4.0	6.6	0.6	0.1
		1.00	2.6 T	1.9	3.0	6.2	0.6	0.1
	7	.0	3.2 C	0.0	4.7	7.9	0.7	0.0
		1.00	3.2 C	0.0	3.7	6.9	0.7	0.0
	8	.0	2.6 T	0.0	4.1	6.7	0.6	0.0
		1.00	2.6 T	0.0	3.0	5.7	0.6	0.0
29	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0
	2	.0	0.0 C	1.7	0.0	1.7	0.0	0.1
		1.00	0.0 C	0.8	0.0	0.8	0.0	0.1
	3	.0	0.5 C	0.0	0.6	1.1	0.1	0.0
		1.00	0.5 C	0.0	0.6	1.1	0.1	0.0
	4	.0	1.6 C	0.0	2.3	3.9	0.4	0.0
		1.00	1.6 C	0.0	2.5	4.2	0.4	0.0
	5	.0	2.2 C	1.7	3.0	5.7	0.5	0.1
		1.00	2.2 C	0.8	3.3	5.6	0.5	0.1
	6	.0	1.0 T	1.7	1.6	3.3	0.3	0.1
		1.00	1.0 T	0.8	1.8	3.0	0.3	0.1
	7	.0	2.2 C	0.0	3.0	5.2	0.5	0.0
		1.00	2.2 C	0.0	3.3	5.5	0.5	0.0
	8	.0	1.1 T	0.0	1.6	2.6	0.3	0.0
		1.00	1.0 T	0.0	1.8	2.8	0.3	0.0
30	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0
	2	.0	0.0 C	1.1	0.0	1.1	0.0	0.1
		1.00	0.0 C	0.1	0.0	0.2	0.0	0.1
	3	.0	0.5 C	0.0	0.6	1.1	0.1	0.0
		1.00	0.5 C	0.0	0.8	1.3	0.1	0.0
	4	.0	1.6 C	0.0	2.5	4.2	0.3	0.0
		1.00	1.6 C	0.0	1.5	3.1	0.3	0.0
	5	.0	2.2 C	1.1	3.3	5.7	0.5	0.1
		1.00	2.2 C	0.1	2.4	4.7	0.5	0.1
	6	.0	1.0 T	1.1	1.8	3.1	0.2	0.1
		1.00	1.0 T	0.1	0.6	1.6	0.2	0.1
	7	.0	2.2 C	0.0	3.3	5.5	0.5	0.0
		1.00	2.2 C	0.0	2.4	4.6	0.5	0.0
	8	.0	1.1 T	0.0	1.8	2.9	0.2	0.0
		1.00	1.1 T	0.0	0.6	1.7	0.2	0.0
41	1	.0	0.1 C	0.0	0.2	0.3	0.0	0.0
		1.00	0.1 C	0.0	0.3	0.4	0.0	0.0
	2	.0	3.1 C	1.7	4.6	7.9	0.6	0.0
		1.00	3.1 C	1.2	7.5	10.7	0.6	0.0

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	3	.0	0.7 C	0.2	0.9	1.6	0.1	0.0
		1.00	0.7 C	0.0	1.7	2.5	0.1	0.0
	4	.0	0.3 T	0.1	0.8	1.1	0.0	0.0
		1.00	0.3 T	0.1	0.8	1.1	0.0	0.0
	5	.0	3.6 C	1.7	6.5	10.3	0.8	0.0
		1.00	3.6 C	1.0	8.7	12.4	0.8	0.0
	6	.0	4.2 C	1.4	4.8	9.2	0.8	0.0
		1.00	4.2 C	1.2	10.4	14.7	0.8	0.0
	7	.0	0.6 C	0.1	1.9	2.4	0.2	0.0
		1.00	0.5 C	0.1	1.2	1.7	0.2	0.0
	8	.0	1.2 C	0.3	0.2	1.5	0.2	0.0
		1.00	1.2 C	0.0	2.9	4.0	0.2	0.0
42	1	.0	0.1 C	0.0	0.3	0.4	0.0	0.0
		1.00	0.1 C	0.0	0.2	0.3	0.0	0.0
	2	.0	3.0 C	1.4	7.5	10.7	0.7	0.0
		1.00	3.0 C	0.8	5.7	8.8	0.7	0.0
	3	.0	0.7 C	0.0	1.7	2.5	0.2	0.0
		1.00	0.7 C	0.1	1.7	2.4	0.2	0.0
	4	.0	0.3 T	0.1	0.8	1.1	0.1	0.0
		1.00	0.3 T	0.3	1.6	1.9	0.1	0.0
	5	.0	3.6 C	1.3	8.7	12.4	0.8	0.0
		1.00	3.6 C	0.7	6.0	9.7	0.8	0.0
	6	.0	4.2 C	1.4	10.4	14.7	1.0	0.0
		1.00	4.2 C	1.2	9.2	13.5	1.0	0.0
	7	.0	0.6 C	0.1	1.2	1.7	0.1	0.0
		1.00	0.5 C	0.1	0.3	0.9	0.1	0.0
	8	.0	1.1 C	0.0	2.9	4.0	0.3	0.0
		1.00	1.1 C	0.4	3.5	4.6	0.3	0.0
43	1	.0	0.1 C	0.0	0.2	0.3	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0
	2	.0	1.5 C	4.8	2.8	7.1	0.3	0.2
		1.00	1.5 C	0.5	3.0	4.6	0.3	0.2
	3	.0	0.5 C	0.0	1.2	1.6	0.1	0.0
		1.00	0.5 C	0.0	0.9	1.3	0.1	0.0
	4	.0	0.9 T	0.0	1.6	2.5	0.2	0.0
		1.00	0.9 T	0.0	1.7	2.5	0.2	0.0
	5	.0	1.2 C	4.8	2.6	6.6	0.3	0.2
		1.00	1.1 C	0.5	2.4	3.6	0.3	0.2
	6	.0	2.9 C	4.8	5.8	10.5	0.6	0.2
		1.00	2.9 C	0.5	5.7	8.6	0.6	0.2
	7	.0	0.3 T	0.0	0.2	0.6	0.1	0.0
		1.00	0.3 T	0.0	0.6	1.0	0.0	0.0
	8	.0	1.4 C	0.0	2.9	4.4	0.3	0.0
		1.00	1.4 C	0.0	2.7	4.1	0.3	0.0
44	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.1	0.0	0.0

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	2	.0	1.5 C	0.3	3.0	4.5	0.3	0.2
		1.00	1.5 C	4.0	3.5	6.8	0.3	0.2
	3	.0	0.5 C	0.0	0.9	1.4	0.1	0.0
		1.00	0.5 C	0.0	0.9	1.4	0.1	0.0
	4	.0	0.9 T	0.0	1.7	2.5	0.2	0.0
		1.00	0.9 T	0.0	2.5	3.4	0.2	0.0
	5	.0	1.1 C	0.3	2.4	3.5	0.2	0.2
		1.00	1.1 C	4.0	2.0	5.6	0.2	0.2
	6	.0	2.9 C	0.3	5.7	8.6	0.7	0.2
		1.00	2.9 C	4.0	6.9	10.9	0.7	0.2
	7	.0	0.3 T	0.0	0.6	1.0	0.1	0.0
		1.00	0.3 T	0.0	1.5	1.9	0.1	0.0
	8	.0	1.4 C	0.0	2.7	4.1	0.3	0.0
		1.00	1.4 C	0.0	3.5	4.9	0.3	0.0
45	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0
	2	.0	0.6 C	1.6	1.3	2.7	0.1	0.1
		1.00	0.6 C	0.4	0.8	1.5	0.1	0.1
	3	.0	0.4 C	0.0	0.9	1.3	0.1	0.0
		1.00	0.4 C	0.0	0.8	1.2	0.1	0.0
	4	.0	1.2 T	0.0	2.6	3.8	0.3	0.0
		1.00	1.2 T	0.0	2.3	3.5	0.3	0.0
	5	.0	0.1 T	1.6	0.3	1.8	0.1	0.1
		1.00	0.1 T	0.4	0.6	0.9	0.0	0.1
	6	.0	2.3 C	1.5	4.9	7.5	0.5	0.1
		1.00	2.3 C	0.5	4.0	6.4	0.5	0.1
	7	.0	0.7 T	0.0	1.6	2.4	0.2	0.0
		1.00	0.7 T	0.0	1.4	2.1	0.2	0.0
	8	.0	1.7 C	0.0	3.6	5.3	0.4	0.0
		1.00	1.7 C	0.0	3.2	5.0	0.4	0.0
46	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.1	0.0	0.0
	2	.0	0.6 C	0.6	0.8	1.6	0.1	0.1
		1.00	0.6 C	2.6	2.0	3.9	0.1	0.1
	3	.0	0.4 C	0.0	0.8	1.2	0.1	0.0
		1.00	0.4 C	0.0	0.9	1.3	0.1	0.0
	4	.0	1.2 T	0.0	2.3	3.5	0.3	0.0
		1.00	1.2 T	0.0	3.0	4.2	0.3	0.0
	5	.0	0.1 T	0.6	0.6	1.0	0.0	0.1
		1.00	0.1 T	2.6	0.0	2.7	0.0	0.1
	6	.0	2.3 C	0.6	4.0	6.4	0.5	0.1
		1.00	2.3 C	2.6	6.0	8.8	0.5	0.1
	7	.0	0.7 T	0.0	1.4	2.1	0.2	0.0
		1.00	0.7 T	0.0	2.0	2.7	0.2	0.0
	8	.0	1.7 C	0.0	3.2	5.0	0.4	0.0
		1.00	1.7 C	0.0	4.0	5.7	0.4	0.0

Plate D-25

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
47	1	.0	0.1 C	0.0	0.1	0.1	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0
	2	.0	0.6 C	2.6	2.0	3.9	0.1	0.1
		1.00	0.6 C	0.6	0.8	1.6	0.1	0.1
	3	.0	0.4 C	0.0	0.9	1.3	0.1	0.0
		1.00	0.4 C	0.0	0.8	1.2	0.1	0.0
	4	.0	1.2 T	0.0	3.0	4.2	0.3	0.0
		1.00	1.2 T	0.0	2.3	3.5	0.3	0.0
	5	.0	0.1 T	2.6	0.0	2.7	0.0	0.1
		1.00	0.1 T	0.6	0.6	1.0	0.0	0.1
	6	.0	2.3 C	2.6	6.0	8.8	0.5	0.1
		1.00	2.3 C	0.6	4.0	6.4	0.5	0.1
	7	.0	0.7 T	0.0	2.0	2.7	0.2	0.0
		1.00	0.7 T	0.0	1.4	2.1	0.2	0.0
	8	.0	1.7 C	0.0	4.0	5.7	0.4	0.0
		1.00	1.7 C	0.0	3.2	5.0	0.4	0.0
48	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0
	2	.0	0.6 C	0.4	0.8	1.5	0.1	0.1
		1.00	0.6 C	1.6	1.3	2.7	0.1	0.1
	3	.0	0.4 C	0.0	0.8	1.2	0.1	0.0
		1.00	0.4 C	0.0	0.9	1.3	0.1	0.0
	4	.0	1.2 T	0.0	2.3	3.5	0.3	0.0
		1.00	1.2 T	0.0	2.6	3.8	0.3	0.0
	5	.0	0.1 T	0.4	0.6	0.9	0.0	0.1
		1.00	0.1 T	1.6	0.3	1.8	0.1	0.1
	6	.0	2.3 C	0.5	4.0	6.4	0.5	0.1
		1.00	2.3 C	1.5	4.9	7.5	0.5	0.1
	7	.0	0.7 T	0.0	1.4	2.1	0.2	0.0
		1.00	0.7 T	0.0	1.6	2.4	0.2	0.0
	8	.0	1.7 C	0.0	3.2	5.0	0.4	0.0
		1.00	1.7 C	0.0	3.6	5.3	0.4	0.0
49	1	.0	0.1 C	0.0	0.1	0.1	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0
	2	.0	1.5 C	4.0	3.5	6.8	0.3	0.2
		1.00	1.5 C	0.3	3.0	4.5	0.3	0.2
	3	.0	0.5 C	0.0	0.9	1.4	0.1	0.0
		1.00	0.5 C	0.0	0.9	1.4	0.1	0.0
	4	.0	0.9 T	0.0	2.5	3.4	0.2	0.0
		1.00	0.9 T	0.0	1.7	2.5	0.2	0.0
	5	.0	1.1 C	4.0	2.0	5.6	0.2	0.2
		1.00	1.1 C	0.3	2.4	3.5	0.2	0.2
	6	.0	2.9 C	4.0	6.9	10.9	0.7	0.2
		1.00	2.9 C	0.3	5.7	8.6	0.7	0.2

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	7	.0	0.3 T	0.0	1.5	1.9	0.1	0.0
		1.00	0.3 T	0.0	0.6	1.0	0.1	0.0
	8	.0	1.4 C	0.0	3.5	4.9	0.3	0.0
		1.00	1.4 C	0.0	2.7	4.1	0.3	0.0
50	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.2	0.3	0.0	0.0
	2	.0	1.5 C	0.5	3.0	4.6	0.3	0.2
		1.00	1.5 C	4.8	2.8	7.1	0.3	0.2
	3	.0	0.5 C	0.0	0.9	1.3	0.1	0.0
		1.00	0.5 C	0.0	1.2	1.6	0.1	0.0
	4	.0	0.9 T	0.0	1.7	2.5	0.2	0.0
		1.00	0.9 T	0.0	1.6	2.5	0.2	0.0
	5	.0	1.1 C	0.5	2.4	3.6	0.3	0.2
		1.00	1.2 C	4.8	2.6	6.6	0.3	0.2
	6	.0	2.9 C	0.5	5.7	8.6	0.6	0.2
		1.00	2.9 C	4.8	5.8	10.5	0.6	0.2
	7	.0	0.3 T	0.0	0.6	1.0	0.0	0.0
		1.00	0.3 T	0.0	0.2	0.6	0.1	0.0
	8	.0	1.4 C	0.0	2.7	4.1	0.3	0.0
		1.00	1.4 C	0.0	2.9	4.4	0.3	0.0
51	1	.0	0.1 C	0.0	0.2	0.3	0.0	0.0
		1.00	0.1 C	0.0	0.3	0.4	0.0	0.0
	2	.0	3.0 C	0.8	5.7	8.8	0.7	0.0
		1.00	3.0 C	1.4	7.5	10.7	0.7	0.0
	3	.0	0.7 C	0.1	1.7	2.4	0.2	0.0
		1.00	0.7 C	0.0	1.7	2.5	0.2	0.0
	4	.0	0.3 T	0.3	1.6	1.9	0.1	0.0
		1.00	0.3 T	0.1	0.8	1.1	0.1	0.0
	5	.0	3.6 C	0.7	6.0	9.7	0.8	0.0
		1.00	3.6 C	1.3	8.7	12.4	0.8	0.0
	6	.0	4.2 C	1.2	9.2	13.5	1.0	0.0
		1.00	4.2 C	1.4	10.4	14.7	1.0	0.0
	7	.0	0.5 C	0.1	0.3	0.9	0.1	0.0
		1.00	0.6 C	0.1	1.2	1.7	0.1	0.0
	8	.0	1.1 C	0.4	3.5	4.6	0.3	0.0
		1.00	1.1 C	0.0	2.9	4.0	0.3	0.0
52	1	.0	0.1 C	0.0	0.3	0.4	0.0	0.0
		1.00	0.1 C	0.0	0.2	0.3	0.0	0.0
	2	.0	3.1 C	1.2	7.5	10.7	0.6	0.0
		1.00	3.1 C	1.7	4.6	7.9	0.6	0.0
	3	.0	0.7 C	0.0	1.7	2.5	0.1	0.0
		1.00	0.7 C	0.2	0.9	1.6	0.1	0.0
	4	.0	0.3 T	0.1	0.8	1.1	0.0	0.0
		1.00	0.3 T	0.1	0.8	1.1	0.0	0.0

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	5	.0	3.6 C	1.0	8.7	12.4	0.8	0.0
		1.00	3.6 C	1.7	6.5	10.3	0.8	0.0
	6	.0	4.2 C	1.2	10.4	14.7	0.8	0.0
		1.00	4.2 C	1.4	4.8	9.2	0.8	0.0
	7	.0	0.5 C	0.1	1.2	1.7	0.2	0.0
		1.00	0.6 C	0.1	1.9	2.4	0.2	0.0
	8	.0	1.2 C	0.0	2.9	4.0	0.2	0.0
		1.00	1.2 C	0.3	0.2	1.5	0.2	0.0
101	1	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	0.3 C	2.0	4.4	5.2	0.4	0.2
		1.00	0.3 C	2.0	4.4	5.2	0.4	0.2
	3	.0	0.1 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.0	0.0
	4	.0	0.1 T	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 T	0.0	0.1	0.2	0.0	0.0
	5	.0	0.3 C	2.0	4.3	5.1	0.4	0.2
		1.00	0.3 C	2.0	4.5	5.2	0.4	0.2
	6	.0	0.6 C	1.9	4.4	5.4	0.4	0.2
		1.00	0.6 C	2.1	4.4	5.4	0.4	0.2
	7	.0	0.0 T	0.0	0.1	0.1	0.0	0.0
		1.00	0.0 T	0.0	0.1	0.1	0.0	0.0
	8	.0	0.2 C	0.0	0.0	0.3	0.0	0.0
		1.00	0.2 C	0.0	0.0	0.3	0.0	0.0
102	1	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	0.3 C	4.9	3.2	6.2	0.3	0.4
		1.00	0.3 C	4.9	3.2	6.2	0.3	0.4
	3	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	4	.0	0.2 T	0.0	0.0	0.3	0.0	0.0
		1.00	0.2 T	0.0	0.0	0.3	0.0	0.0
	5	.0	0.1 C	4.9	3.2	6.0	0.3	0.4
		1.00	0.1 C	4.9	3.2	6.0	0.3	0.4
	6	.0	0.6 C	4.9	3.2	6.4	0.3	0.4
		1.00	0.6 C	5.0	3.2	6.5	0.3	0.4
	7	.0	0.2 T	0.0	0.0	0.2	0.0	0.0
		1.00	0.2 T	0.0	0.0	0.2	0.0	0.0
	8	.0	0.3 C	0.0	0.0	0.3	0.0	0.0
		1.00	0.3 C	0.0	0.0	0.3	0.0	0.0
103	1	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	0.3 C	0.0	0.5	0.8	0.0	0.0
		1.00	0.3 C	0.0	0.5	0.8	0.0	0.0

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	3	.0	0.0 T	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.0	0.0	0.0
	4	.0	0.3 T	0.0	0.0	0.3	0.0	0.0
		1.00	0.3 T	0.0	0.0	0.3	0.0	0.0
	5	.0	0.1 C	0.0	0.4	0.5	0.0	0.0
		1.00	0.1 C	0.0	0.5	0.6	0.1	0.0
	6	.0	0.6 C	0.0	0.5	1.1	0.0	0.0
		1.00	0.6 C	0.0	0.4	1.0	0.1	0.0
	7	.0	0.3 T	0.0	0.0	0.3	0.0	0.0
		1.00	0.3 T	0.0	0.0	0.3	0.0	0.0
	8	.0	0.3 C	0.0	0.0	0.3	0.0	0.0
		1.00	0.3 C	0.0	0.0	0.3	0.0	0.0
104	1	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	0.3 C	4.9	3.2	6.2	0.3	0.4
		1.00	0.3 C	4.9	3.2	6.2	0.3	0.4
	3	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	4	.0	0.2 T	0.0	0.0	0.3	0.0	0.0
		1.00	0.2 T	0.0	0.0	0.3	0.0	0.0
	5	.0	0.1 C	4.9	3.2	6.0	0.3	0.4
		1.00	0.1 C	4.9	3.2	6.0	0.3	0.4
	6	.0	0.6 C	4.9	3.2	6.4	0.3	0.4
		1.00	0.6 C	5.0	3.2	6.5	0.3	0.4
	7	.0	0.2 T	0.0	0.0	0.2	0.0	0.0
		1.00	0.2 T	0.0	0.0	0.2	0.0	0.0
	8	.0	0.3 C	0.0	0.0	0.3	0.0	0.0
		1.00	0.3 C	0.0	0.0	0.3	0.0	0.0
105	1	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	0.3 C	2.0	4.4	5.2	0.4	0.2
		1.00	0.3 C	2.0	4.4	5.2	0.4	0.2
	3	.0	0.1 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.0	0.0
	4	.0	0.1 T	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 T	0.0	0.1	0.2	0.0	0.0
	5	.0	0.3 C	2.0	4.3	5.1	0.4	0.2
		1.00	0.3 C	2.0	4.5	5.2	0.4	0.2
	6	.0	0.6 C	1.9	4.4	5.4	0.4	0.2
		1.00	0.6 C	2.1	4.4	5.4	0.4	0.2
	7	.0	0.0 T	0.0	0.1	0.1	0.0	0.0
		1.00	0.0 T	0.0	0.1	0.1	0.0	0.0
	8	.0	0.2 C	0.0	0.0	0.3	0.0	0.0
		1.00	0.2 C	0.0	0.0	0.3	0.0	0.0
120	1	.0	0.1 C	0.0	0.3	0.3	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0

Plate D-29

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	2	.0	2.1 T	4.1	3.9	7.8	0.2	0.1
		1.00	2.1 T	0.3	3.0	5.1	0.2	0.1
	3	.0	0.3 C	0.0	1.2	1.5	0.1	0.0
		1.00	0.3 C	0.0	0.7	1.1	0.1	0.0
	4	.0	0.8 C	0.3	1.0	1.9	0.0	0.0
		1.00	0.8 C	0.6	0.0	1.4	0.0	0.0
	5	.0	0.9 T	3.7	3.5	6.1	0.2	0.1
		1.00	0.9 T	0.2	2.2	3.1	0.2	0.1
	6	.0	2.5 T	4.4	1.5	7.1	0.1	0.2
		1.00	2.5 T	0.9	2.1	4.9	0.1	0.2
	7	.0	1.2 C	0.3	0.4	1.7	0.1	0.0
		1.00	1.2 C	0.5	0.8	2.2	0.0	0.0
	8	.0	0.4 T	0.3	2.5	2.9	0.1	0.0
		1.00	0.4 T	0.6	0.8	1.5	0.1	0.0

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
121	1	.0	0.0 T	0.0	0.1	0.1	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.1	0.0	0.0
	2	.0	2.3 C	0.6	0.6	3.2	0.1	0.0
		1.00	2.3 C	0.4	1.2	3.6	0.1	0.0
	3	.0	0.2 T	0.1	0.2	0.5	0.0	0.0
		1.00	0.2 T	0.2	0.3	0.6	0.0	0.0
	4	.0	0.5 T	0.2	0.6	1.2	0.0	0.0
		1.00	0.5 T	0.1	0.1	0.7	0.0	0.0
	5	.0	1.5 C	0.5	0.9	2.6	0.1	0.0
		1.00	1.5 C	0.1	0.9	2.4	0.1	0.0
	6	.0	2.6 C	1.0	0.2	3.6	0.0	0.0
		1.00	2.6 C	0.3	0.8	3.4	0.0	0.0
	7	.0	0.8 T	0.1	0.3	1.1	0.0	0.0
		1.00	0.8 T	0.3	0.3	1.2	0.0	0.0
	8	.0	0.3 C	0.4	0.9	1.2	0.0	0.0
		1.00	0.3 C	0.1	0.4	0.7	0.0	0.0

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
122	1	.0	0.0 T	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 T	0.0	0.1	0.1	0.0	0.0
	2	.0	0.9 T	0.6	0.5	1.7	0.0	0.1
		1.00	0.9 T	1.8	1.2	3.1	0.0	0.1
	3	.0	0.0 T	0.0	0.2	0.2	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.0	0.0	0.0
	4	.0	0.9 C	0.1	0.0	1.0	0.0	0.0
		1.00	0.9 C	0.1	0.1	1.1	0.0	0.0
	5	.0	0.1 T	0.7	0.4	0.8	0.0	0.1
		1.00	0.1 T	1.9	1.1	2.3	0.0	0.1
	6	.0	1.9 .	0.6	0.3	2.5	0.0	0.1
		1.00	1.9 T	1.7	1.4	4.1	0.0	0.1
	7	.0	0.9 C	0.1	0.1	1.0	0.0	0.0
		1.00	0.9 C	0.1	0.0	1.0	0.0	0.0
	8	.0	1.0 T	0.0	0.2	1.2	0.0	0.0
		1.00	1.0 T	0.1	0.2	1.2	0.0	0.0

Plate D-20

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
123	1	.0	0.0 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	1.0 C	1.3	1.7	3.2	0.1	0.0
		1.00	1.0 C	0.3	0.3	1.5	0.1	0.0
	3	.0	0.1 C	0.1	0.0	0.2	0.0	0.0
		1.00	0.1 C	0.1	0.0	0.1	0.0	0.0
	4	.0	0.1 T	0.4	0.1	0.5	0.0	0.0
		1.00	0.1 T	0.1	0.0	0.2	0.0	0.0
	5	.0	1.0 C	1.0	1.8	3.0	0.1	0.0
		1.00	1.0 C	0.1	0.3	1.3	0.1	0.0
	6	.0	1.2 C	1.8	1.6	3.5	0.1	0.0
		1.00	1.2 C	0.4	0.3	1.7	0.1	0.0
	7	.0	0.0 T	0.3	0.0	0.3	0.0	0.0
		1.00	0.0 T	0.2	0.1	0.3	0.0	0.0
	8	.0	0.2 C	0.5	0.2	0.7	0.0	0.0
		1.00	0.1 C	0.1	0.0	0.2	0.0	0.0
124	1	.0	0.0 T	0.0	0.0	0.1	0.0	0.0
		1.00	0.0 T	0.0	0.1	0.1	0.0	0.0
	2	.0	0.4 T	0.1	0.7	1.0	0.0	0.0
		1.00	0.4 T	0.7	0.5	1.3	0.0	0.0
	3	.0	0.1 T	0.0	0.0	0.1	0.0	0.0
		1.00	0.1 T	0.0	0.0	0.1	0.0	0.0
	4	.0	0.8 C	0.0	0.0	0.8	0.0	0.0
		1.00	0.8 C	0.0	0.1	0.9	0.0	0.0
	5	.0	0.3 C	0.1	0.7	1.0	0.0	0.0
		1.00	0.3 C	0.8	0.7	1.3	0.0	0.0
	6	.0	1.2 T	0.2	0.7	2.0	0.0	0.0
		1.00	1.2 T	0.7	0.4	2.1	0.0	0.0
	7	.0	0.6 C	0.1	0.1	0.7	0.0	0.0
		1.00	0.6 C	0.1	0.1	0.8	0.0	0.0
	8	.0	0.9 T	0.0	0.1	0.9	0.0	0.0
		1.00	0.9 T	0.0	0.1	1.0	0.0	0.0
125	1	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	0.2 C	0.6	1.3	1.6	0.1	0.0
		1.00	0.2 C	0.2	0.5	0.8	0.1	0.0
	3	.0	0.0 C	0.1	0.1	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.1	0.0	0.0
	4	.0	0.4 C	0.2	0.3	0.7	0.0	0.0
		1.00	0.4 C	0.1	0.1	0.5	0.0	0.0
	5	.0	0.6 C	0.6	1.1	1.8	0.0	0.0
		1.00	0.6 C	0.1	0.7	1.2	0.1	0.0
	6	.0	0.2 T	0.3	1.6	1.8	0.1	0.0
		1.00	0.2 T	0.2	0.5	0.8	0.1	0.0

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	7	.0	0.4 C	0.1	0.2	0.6	0.0	0.0
		1.00	0.4 C	0.1	0.1	0.6	0.0	0.0
	8	.0	0.4 T	0.3	0.3	0.8	0.0	0.0
		1.00	0.4 T	0.0	0.0	0.4	0.0	0.0
126	1	.0	0.0 T	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.0	0.0	0.0
	2	.0	0.2 C	0.2	0.5	0.8	0.1	0.0
		1.00	0.2 C	0.6	1.3	1.6	0.1	0.0
	3	.0	0.0 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.0 C	0.1	0.1	0.1	0.0	0.0
	4	.0	0.4 C	0.1	0.1	0.5	0.0	0.0
		1.00	0.4 C	0.2	0.3	0.7	0.0	0.0
	5	.0	0.6 C	0.1	0.7	1.2	0.1	0.0
		1.00	0.6 C	0.6	1.1	1.8	0.0	0.0
	6	.0	0.2 T	0.2	0.5	0.8	0.1	0.0
		1.00	0.2 T	0.3	1.6	1.8	0.1	0.0
	7	.0	0.4 C	0.1	0.1	0.6	0.0	0.0
		1.00	0.4 C	0.1	0.2	0.6	0.0	0.0
	8	.0	0.4 T	0.0	0.0	0.4	0.0	0.0
		1.00	0.4 T	0.3	0.3	0.8	0.0	0.0
127	1	.0	0.0 T	0.0	0.1	0.1	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.1	0.0	0.0
	2	.0	0.4 T	0.7	0.5	1.3	0.0	0.0
		1.00	0.4 T	0.1	0.7	1.0	0.0	0.0
	3	.0	0.1 T	0.0	0.0	0.1	0.0	0.0
		1.00	0.1 T	0.0	0.0	0.1	0.0	0.0
	4	.0	0.8 C	0.0	0.1	0.9	0.0	0.0
		1.00	0.8 C	0.0	0.0	0.8	0.0	0.0
	5	.0	0.3 C	0.8	0.7	1.3	0.0	0.0
		1.00	0.3 C	0.1	0.7	1.0	0.0	0.0
	6	.0	1.2 T	0.7	0.4	2.1	0.0	0.0
		1.00	1.2 T	0.2	0.7	2.0	0.0	0.0
	7	.0	0.6 C	0.1	0.1	0.8	0.0	0.0
		1.00	0.6 C	0.1	0.1	0.7	0.0	0.0
	8	.0	0.9 T	0.0	0.1	1.0	0.0	0.0
		1.00	0.9 T	0.0	0.1	0.9	0.0	0.0
128	1	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.1	0.0	0.0
	2	.0	1.0 C	0.3	0.3	1.5	0.1	0.0
		1.00	1.0 C	1.3	1.7	3.2	0.1	0.0
	3	.0	0.1 C	0.1	0.0	0.1	0.0	0.0
		1.00	0.1 C	0.1	0.0	0.2	0.0	0.0
	4	.0	0.1 T	0.1	0.0	0.2	0.0	0.0
		1.00	0.1 T	0.4	0.1	0.5	0.0	0.0

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	5	.0	1.0 C	0.1	0.3	1.3	0.1	0.0
		1.00	1.0 C	1.0	1.8	3.0	0.1	0.0
	6	.0	1.2 C	0.4	0.3	1.7	0.1	0.0
		1.00	1.2 C	1.8	1.6	3.5	0.1	0.0
	7	.0	0.0 T	0.2	0.1	0.3	0.0	0.0
		1.00	0.0 T	0.3	0.0	0.3	0.0	0.0
	8	.0	0.1 C	0.1	0.0	0.2	0.0	0.0
		1.00	0.2 C	0.5	0.2	0.7	0.0	0.0
129	1	.0	0.0 T	0.0	0.1	0.1	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.0	0.0	0.0
	2	.0	0.9 T	1.8	1.2	3.1	0.0	0.1
		1.00	0.9 T	0.6	0.5	1.7	0.0	0.1
	3	.0	0.0 T	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 T	0.0	0.2	0.2	0.0	0.0
	4	.0	0.9 C	0.1	0.1	1.1	0.0	0.0
		1.00	0.9 C	0.1	0.0	1.0	0.0	0.0
	5	.0	0.1 T	1.9	1.1	2.3	0.0	0.1
		1.00	0.1 T	0.7	0.4	0.8	0.0	0.1
	6	.0	1.9 T	1.7	1.4	4.1	0.0	0.1
		1.00	1.9 T	0.6	0.3	2.5	0.0	0.1
	7	.0	0.9 C	0.1	0.0	1.0	0.0	0.0
		1.00	0.9 C	0.1	0.1	1.0	0.0	0.0
	8	.0	1.0 T	0.1	0.2	1.2	0.0	0.0
		1.00	1.0 T	0.0	0.2	1.2	0.0	0.0
130	1	.0	0.0 T	0.0	0.0	0.1	0.0	0.0
		1.00	0.0 T	0.0	0.1	0.1	0.0	0.0
	2	.0	2.3 C	0.4	1.2	3.6	0.1	0.0
		1.00	2.3 C	0.6	0.6	3.2	0.1	0.0
	3	.0	0.2 T	0.2	0.3	0.6	0.0	0.0
		1.00	0.2 T	0.1	0.2	0.5	0.0	0.0
	4	.0	0.5 T	0.1	0.1	0.7	0.0	0.0
		1.00	0.5 T	0.2	0.6	1.2	0.0	0.0
	5	.0	1.5 C	0.1	0.9	2.4	0.1	0.0
		1.00	1.5 C	0.5	0.9	2.6	0.1	0.0
	6	.0	2.6 C	0.3	0.8	3.4	0.0	0.0
		1.00	2.6 C	1.0	0.2	3.6	0.0	0.0
	7	.0	0.8 T	0.3	0.3	1.2	0.0	0.0
		1.00	0.8 T	0.1	0.3	1.1	0.0	0.0
	8	.0	0.3 C	0.1	0.4	0.7	0.0	0.0
		1.00	0.3 C	0.4	0.9	1.2	0.0	0.0
131	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.3	0.3	0.0	0.0
	2	.0	2.1 T	0.3	3.0	5.1	0.2	0.1
		1.00	2.1 T	4.1	3.9	7.8	0.2	0.1

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	3	.0	0.3 C	0.0	0.7	1.1	0.1	0.0
		1.00	0.3 C	0.0	1.2	1.5	0.1	0.0
	4	.0	0.8 C	0.6	0.0	1.4	0.0	0.0
		1.00	0.8 C	0.3	1.0	1.9	0.0	0.0
	5	.0	0.9 T	0.2	2.2	3.1	0.2	0.1
		1.00	0.9 T	3.7	3.5	6.1	0.2	0.1
	6	.0	2.5 T	0.9	2.1	4.9	0.1	0.2
		1.00	2.5 T	4.4	1.5	7.1	0.1	0.2
	7	.0	1.2 C	0.5	0.8	2.2	0.0	0.0
		1.00	1.2 C	0.3	0.4	1.7	0.1	0.0
	8	.0	0.4 T	0.6	0.8	1.5	0.1	0.0
		1.00	0.4 T	0.3	2.5	2.9	0.1	0.0
140	1	.0	0.1 C	0.0	0.3	0.3	0.0	0.0
		1.00	0.1 C	0.0	0.1	0.2	0.0	0.0
	2	.0	2.1 C	4.4	3.9	8.0	0.2	0.2
		1.00	2.1 C	0.6	3.0	5.2	0.2	0.2
	3	.0	0.3 C	0.0	1.2	1.5	0.1	0.0
		1.00	0.3 C	0.0	0.7	1.1	0.1	0.0
	4	.0	0.8 C	0.3	1.0	1.9	0.0	0.0
		1.00	0.8 C	0.6	0.0	1.4	0.0	0.0
	5	.0	3.3 C	4.7	4.3	9.7	0.3	0.2
		1.00	3.3 C	1.2	3.8	7.3	0.2	0.2
	6	.0	1.7 C	4.1	6.3	9.2	0.3	0.1
		1.00	1.7 C	0.0	3.8	5.5	0.3	0.1
	7	.0	1.2 C	0.3	0.4	1.7	0.1	0.0
		1.00	1.2 C	0.5	0.8	2.2	0.0	0.0
	8	.0	0.4 T	0.3	2.5	2.9	0.1	0.0
		1.00	0.4 T	0.6	0.8	1.5	0.1	0.0
141	1	.0	0.0 T	0.0	0.1	0.1	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.1	0.0	0.0
	2	.0	2.3 T	0.5	0.6	3.1	0.1	0.0
		1.00	2.3 T	0.5	1.2	3.6	0.1	0.0
	3	.0	0.2 T	0.1	0.2	0.5	0.0	0.0
		1.00	0.2 T	0.2	0.3	0.6	0.0	0.0
	4	.0	0.5 T	0.2	0.6	1.2	0.0	0.0
		1.00	0.5 T	0.1	0.1	0.7	0.0	0.0
	5	.0	3.1 T	0.6	0.3	3.8	0.1	0.0
		1.00	3.1 T	0.7	1.5	4.7	0.0	0.0
	6	.0	2.0 T	0.2	1.5	3.5	0.1	0.0
		1.00	2.0 T	0.6	1.6	3.7	0.1	0.0
	7	.0	0.8 T	0.1	0.3	1.1	0.0	0.0
		1.00	0.8 T	0.3	0.3	1.2	0.0	0.0
	8	.0	0.3 C	0.4	0.9	1.2	0.0	0.0
		1.00	0.3 C	0.1	0.4	0.7	0.0	0.0
142	1	.0	0.0 T	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 T	0.0	0.1	0.1	0.0	0.0

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	2	.0	1.0 C	0.6	0.5	1.7	0.0	0.1
		1.00	1.0 C	1.8	1.2	3.1	0.0	0.1
	3	.0	0.0 T	0.0	0.2	0.2	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.0	0.0	0.0
	4	.0	0.9 C	0.1	0.0	1.0	0.0	0.0
		1.00	0.9 C	0.1	0.1	1.1	0.0	0.0
	5	.0	1.9 C	0.5	0.6	2.6	0.0	0.1
		1.00	1.9 C	1.7	1.3	4.0	0.0	0.1
	6	.0	0.0 C	0.6	0.7	0.9	0.0	0.1
		1.00	0.0 C	1.9	1.0	2.1	0.0	0.1
	7	.0	0.9 C	0.1	0.1	1.0	0.0	0.0
		1.00	0.9 C	0.1	0.0	1.0	0.0	0.0
	8	.0	1.0 T	0.0	0.2	1.2	0.0	0.0
		1.00	1.0 T	0.1	0.2	1.2	0.0	0.0
143	1	.0	0.0 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	1.0 T	1.3	1.7	3.1	0.1	0.0
		1.00	1.0 T	0.3	0.3	1.5	0.1	0.0
	3	.0	0.1 C	0.1	0.0	0.2	0.0	0.0
		1.00	0.1 C	0.1	0.0	0.1	0.0	0.0
	4	.0	0.1 T	0.4	0.1	0.5	0.0	0.0
		1.00	0.1 T	0.1	0.0	0.2	0.0	0.0
	5	.0	1.1 T	1.5	1.7	3.3	0.1	0.0
		1.00	1.1 T	0.6	0.4	1.7	0.1	0.0
	6	.0	0.9 T	0.8	1.9	2.9	0.1	0.0
		1.00	0.9 T	0.3	0.3	1.3	0.1	0.0
	7	.0	0.0 T	0.3	0.0	0.3	0.0	0.0
		1.00	0.0 T	0.2	0.1	0.3	0.0	0.0
	8	.0	0.2 C	0.5	0.2	0.7	0.0	0.0
		1.00	0.1 C	0.1	0.0	0.2	0.0	0.0
144	1	.0	0.0 T	0.0	0.0	0.1	0.0	0.0
		1.00	0.0 T	0.0	0.1	0.1	0.0	0.0
	2	.0	0.4 C	0.1	0.6	1.0	0.0	0.0
		1.00	0.4 C	0.8	0.5	1.4	0.0	0.0
	3	.0	0.1 T	0.0	0.0	0.1	0.0	0.0
		1.00	0.1 T	0.0	0.0	0.1	0.0	0.0
	4	.0	0.8 C	0.0	0.0	0.8	0.0	0.0
		1.00	0.8 C	0.0	0.1	0.9	0.0	0.0
	5	.0	1.0 C	0.2	0.6	1.6	0.0	0.0
		1.00	1.0 C	0.7	0.4	1.9	0.0	0.0
	6	.0	0.5 T	0.1	0.6	1.1	0.0	0.0
		1.00	0.5 T	0.8	0.7	1.5	0.0	0.0
	7	.0	0.6 C	0.1	0.1	0.7	0.0	0.0
		1.00	0.6 C	0.1	0.1	0.8	0.0	0.0
	8	.0	0.9 T	0.0	0.1	0.9	0.0	0.0
		1.00	0.9 T	0.0	0.1	1.0	0.0	0.0

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
145	1	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	0.2 T	0.5	1.2	1.5	0.1	0.0
		1.00	0.2 T	0.2	0.5	0.7	0.1	0.0
	3	.0	0.0 C	0.1	0.1	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.1	0.0	0.0
	4	.0	0.4 C	0.2	0.3	0.7	0.0	0.0
		1.00	0.4 C	0.1	0.1	0.5	0.0	0.0
	5	.0	0.2 C	0.5	1.4	1.7	0.1	0.0
		1.00	0.2 C	0.3	0.4	0.7	0.1	0.0
	6	.0	0.6 T	0.8	0.9	1.8	0.1	0.0
		1.00	0.6 T	0.2	0.5	1.1	0.0	0.0
	7	.0	0.4 C	0.1	0.2	0.6	0.0	0.0
		1.00	0.4 C	0.1	0.1	0.6	0.0	0.0
	8	.0	0.4 T	0.3	0.3	0.8	0.0	0.0
		1.00	0.4 T	0.0	0.0	0.4	0.0	0.0
146	1	.0	0.0 T	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.0	0.0	0.0
	2	.0	0.2 T	0.2	0.5	0.7	0.1	0.0
		1.00	0.2 T	0.5	1.2	1.5	0.1	0.0
	3	.0	0.0 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.0 C	0.1	0.1	0.1	0.0	0.0
	4	.0	0.4 C	0.1	0.1	0.5	0.0	0.0
		1.00	0.4 C	0.2	0.3	0.7	0.0	0.0
	5	.0	0.2 C	0.3	0.4	0.7	0.1	0.0
		1.00	0.2 C	0.5	1.4	1.7	0.1	0.0
	6	.0	0.6 T	0.2	0.5	1.1	0.0	0.0
		1.00	0.6 T	0.8	0.9	1.8	0.1	0.0
	7	.0	0.4 C	0.1	0.1	0.6	0.0	0.0
		1.00	0.4 C	0.1	0.2	0.6	0.0	0.0
	8	.0	0.4 T	0.0	0.0	0.4	0.0	0.0
		1.00	0.4 T	0.3	0.3	0.8	0.0	0.0
147	1	.0	0.0 T	0.0	0.1	0.1	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.1	0.0	0.0
	2	.0	0.4 C	0.8	0.5	1.4	0.0	0.0
		1.00	0.4 C	0.1	0.6	1.0	0.0	0.0
	3	.0	0.1 T	0.0	0.0	0.1	0.0	0.0
		1.00	0.1 T	0.0	0.0	0.1	0.0	0.0
	4	.0	0.8 C	0.0	0.1	0.9	0.0	0.0
		1.00	0.8 C	0.0	0.0	0.8	0.0	0.0
	5	.0	1.0 C	0.7	0.4	1.9	0.0	0.0
		1.00	1.0 C	0.2	0.6	1.6	0.0	0.0
	6	.0	0.5 T	0.8	0.7	1.5	0.0	0.0
		1.00	0.5 T	0.1	0.6	1.1	0.0	0.0

Plate D-36

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	7	.0	0.6 C	0.1	0.1	0.8	0.0	0.0
		1.00	0.6 C	0.1	0.1	0.7	0.0	0.0
	8	.0	0.9 T	0.0	0.1	1.0	0.0	0.0
		1.00	0.9 T	0.0	0.1	0.9	0.0	0.0
148	1	.0	0.0 C	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.1	0.0	0.0
	2	.0	1.0 T	0.3	0.3	1.5	0.1	0.0
		1.00	1.0 T	1.3	1.7	3.1	0.1	0.0
	3	.0	0.1 C	0.1	0.0	0.1	0.0	0.0
		1.00	0.1 C	0.1	0.0	0.2	0.0	0.0
	4	.0	0.1 T	0.1	0.0	0.2	0.0	0.0
		1.00	0.1 T	0.4	0.1	0.5	0.0	0.0
	5	.0	1.1 T	0.6	0.4	1.7	0.1	0.0
		1.00	1.1 T	1.5	1.7	3.3	0.1	0.0
	6	.0	0.9 T	0.3	0.3	1.3	0.1	0.0
		1.00	0.9 T	0.8	1.9	2.9	0.1	0.0
	7	.0	0.0 T	0.2	0.1	0.3	0.0	0.0
		1.00	0.0 T	0.3	0.0	0.3	0.0	0.0
	8	.0	0.1 C	0.1	0.0	0.2	0.0	0.0
		1.00	0.2 C	0.5	0.2	0.7	0.0	0.0
149	1	.0	0.0 T	0.0	0.1	0.1	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.0	0.0	0.0
	2	.0	1.0 C	1.8	1.2	3.1	0.0	0.1
		1.00	1.0 C	0.6	0.5	1.7	0.0	0.1
	3	.0	0.0 T	0.0	0.0	0.0	0.0	0.0
		1.00	0.0 T	0.0	0.2	0.2	0.0	0.0
	4	.0	0.9 C	0.1	0.1	1.1	0.0	0.0
		1.00	0.9 C	0.1	0.0	1.0	0.0	0.0
	5	.0	1.9 C	1.7	1.3	4.0	0.0	0.1
		1.00	1.9 C	0.5	0.6	2.6	0.0	0.1
	6	.0	0.0 C	1.9	1.0	2.1	0.0	0.1
		1.00	0.0 C	0.6	0.7	0.9	0.0	0.1
	7	.0	0.9 C	0.1	0.0	1.0	0.0	0.0
		1.00	0.9 C	0.1	0.1	1.0	0.0	0.0
	8	.0	1.0 T	0.1	0.2	1.2	0.0	0.0
		1.00	1.0 T	0.0	0.2	1.2	0.0	0.0
150	1	.0	0.0 T	0.0	0.0	0.1	0.0	0.0
		1.00	0.0 T	0.0	0.1	0.1	0.0	0.0
	2	.0	2.3 T	0.5	1.2	3.6	0.1	0.0
		1.00	2.3 T	0.5	0.6	3.1	0.1	0.0
	3	.0	0.2 T	0.2	0.3	0.6	0.0	0.0
		1.00	0.2 T	0.1	0.2	0.5	0.0	0.0
	4	.0	0.5 T	0.1	0.1	0.7	0.0	0.0
		1.00	0.5 T	0.2	0.6	1.2	0.0	0.0

Plate D-37

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	5	.0	3.1 T	0.7	1.5	4.7	0.0	0.0
		1.00	3.1 T	0.6	0.3	3.8	0.1	0.0
	6	.0	2.0 T	0.6	1.6	3.7	0.1	0.0
		1.00	2.0 T	0.2	1.5	3.5	0.1	0.0
	7	.0	0.8 T	0.3	0.3	1.2	0.0	0.0
		1.00	0.8 T	0.1	0.3	1.1	0.0	0.0
	8	.0	0.3 C	0.1	0.4	0.7	0.0	0.0
		1.00	0.3 C	0.4	0.9	1.2	0.0	0.0
151	1	.0	0.1 C	0.0	0.1	0.2	0.0	0.0
		1.00	0.1 C	0.0	0.3	0.3	0.0	0.0
	2	.0	2.1 C	0.6	3.0	5.2	0.2	0.2
		1.00	2.1 C	4.4	3.9	8.0	0.2	0.2
	3	.0	0.3 C	0.0	0.7	1.1	0.1	0.0
		1.00	0.3 C	0.0	1.2	1.5	0.1	0.0
	4	.0	0.8 C	0.6	0.0	1.4	0.0	0.0
		1.00	0.8 C	0.3	1.0	1.9	0.0	0.0
	5	.0	3.3 C	1.2	3.8	7.3	0.2	0.2
		1.00	3.3 C	4.7	4.3	9.7	0.3	0.2
	6	.0	1.7 C	0.0	3.8	5.5	0.3	0.1
		1.00	1.7 C	4.1	6.3	9.2	0.3	0.1
	7	.0	1.2 C	0.5	0.8	2.2	0.0	0.0
		1.00	1.2 C	0.3	0.4	1.7	0.1	0.0
	8	.0	0.4 T	0.6	0.8	1.5	0.1	0.0
		1.00	0.4 T	0.3	2.5	2.9	0.1	0.0
201	1	.0	0.0 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	0.1 T	0.6	1.3	1.9	0.0	0.0
		1.00	0.1 T	0.0	0.0	0.1	0.0	0.0
	3	.0	0.0 C	0.0	0.2	0.3	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	4	.0	0.0 T	0.2	0.4	0.5	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.0	0.0	0.0
	5	.0	0.0 T	0.3	0.7	1.1	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.1	0.0	0.0
	6	.0	0.0 T	0.7	1.4	2.1	0.0	0.0
		1.00	0.0 T	0.1	0.0	0.1	0.0	0.0
	7	.0	0.0 C	0.2	0.6	0.9	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	8	.0	0.0 C	0.1	0.1	0.2	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.1	0.0	0.0
202	1	.0	0.0 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	0.1 T	0.6	1.3	1.9	0.0	0.0
		1.00	0.1 T	0.0	0.0	0.1	0.0	0.0

MEMBER STRESSES

ALL UNITS ARE KIP /SQ IN

MEMB	LD	SECT	AXIAL	BEND-Y	BEND-Z	COMBINED	SHEAR-Y	SHEAR-Z
	3	.0	0.0 C	0.0	0.2	0.3	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	4	.0	0.0 T	0.2	0.4	0.5	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.0	0.0	0.0
	5	.0	0.0 T	0.3	0.7	1.1	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.1	0.0	0.0
	6	.0	0.0 T	0.7	1.4	2.1	0.0	0.0
		1.00	0.0 T	0.1	0.0	0.1	0.0	0.0
	7	.0	0.0 C	0.2	0.6	0.9	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	8	.0	0.0 C	0.1	0.1	0.2	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.1	0.0	0.0
203	1	.0	0.0 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	0.1 C	0.5	1.3	1.9	0.0	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.0	0.0
	3	.0	0.0 C	0.0	0.2	0.3	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	4	.0	0.0	0.2	0.4	0.5	0.0	0.0
		1.00	0.0	0.0	0.0	0.0	0.0	0.0
	5	.0	0.1 C	0.7	2.0	2.7	0.1	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.1	0.0
	6	.0	0.1 C	0.4	1.2	1.7	0.0	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.0	0.0
	7	.0	0.0 C	0.2	0.6	0.9	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	8	.0	0.0 C	0.1	0.1	0.2	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.1	0.0	0.0
204	1	.0	0.0 C	0.0	0.0	0.1	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	2	.0	0.1 C	0.5	1.3	1.9	0.0	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.0	0.0
	3	.0	0.0 C	0.0	0.2	0.3	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	4	.0	0.0 T	0.2	0.4	0.5	0.0	0.0
		1.00	0.0 T	0.0	0.0	0.0	0.0	0.0
	5	.0	0.1 C	0.7	2.0	2.7	0.1	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.1	0.0
	6	.0	0.1 C	0.4	1.2	1.7	0.0	0.0
		1.00	0.1 C	0.0	0.0	0.1	0.0	0.0
	7	.0	0.0 C	0.2	0.6	0.9	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.0	0.0	0.0
	8	.0	0.0 C	0.1	0.1	0.2	0.0	0.0
		1.00	0.0 C	0.0	0.0	0.1	0.0	0.0

************** END OF LATEST ANALYSIS RESULT **************

164. PRINT SUPPORT REACTIONS

SUPPORT REACTIONS -UNIT KIP IN   STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
101	1	-0.68	8.13	0.17	18.81	0.07	87.52
	2	22.90	-36.25	-9.11	-1309.95	-129.12	-3031.77
	3	-4.01	8.00	0.97	112.46	-0.49	524.00
	4	-5.96	0.00	2.90	394.00	10.30	834.32
	5	12.25	-20.12	-5.08	-784.67	-119.24	-1585.92
	6	24.17	-20.12	-10.88	-1572.67	-139.84	-3254.57
	7	-10.65	16.13	4.03	525.28	9.88	1445.85
	8	1.26	16.13	-1.77	-262.72	-10.72	-222.80
113	1	0.68	8.13	0.17	18.81	-0.07	-87.52
	2	-22.90	-36.25	-9.11	-1309.94	129.12	3031.74
	3	4.01	8.00	0.97	112.47	0.49	-524.00
	4	5.96	0.00	2.90	394.00	-10.30	-834.32
	5	-12.25	-20.12	-5.08	-784.66	119.24	1585.91
	6	-24.17	-20.12	-10.88	-1572.65	139.84	3254.54
	7	10.65	16.13	4.03	525.28	-9.88	-1445.84
	8	-1.26	16.13	-1.77	-262.72	10.72	222.80
141	1	-0.68	8.13	-0.17	-18.81	-0.07	87.52
	2	-23.03	36.25	-7.83	-1082.26	-137.81	3047.15
	3	-4.01	8.00	-0.97	-112.46	0.49	524.00
	4	-5.96	0.00	-2.90	-394.00	-10.30	834.33
	5	-33.68	52.37	-11.86	-1607.54	-147.69	4493.00
	6	-21.76	52.37	-6.06	-819.53	-127.09	2824.35
	7	-10.65	16.13	-4.03	-525.28	-9.88	1445.85
	8	1.26	16.13	1.77	262.72	10.72	-222.81
153	1	0.68	8.13	-0.17	-18.81	0.07	-87.52
	2	23.03	36.25	-7.83	-1082.25	137.80	-3047.13
	3	4.01	8.00	-0.97	-112.47	-0.49	-524.00
	4	5.96	0.00	-2.90	-394.00	10.30	-834.32
	5	33.68	52.37	-11.86	-1607.53	147.69	-4492.97
	6	21.76	52.37	-6.06	-819.53	127.09	-2824.33
	7	10.65	16.13	-4.03	-525.28	9.88	-1445.84
	8	-1.26	16.13	1.77	262.72	-10.72	222.80

*************** END OF LATEST ANALYSIS RESULT ***************

165. PLOT BENDING
166. PLOT STRESS
167. PLOT DISPLACEMENT
168. FINISH

*************** END OF STAAD-III ***************

****** DATE= JUL 31,1992   TIME= 10:53:55 ******

Plate D-40

Subject Des Moines Amplitheater		Date Jan 92
Computed by TJW	Checked by JGC	Sheet 1 of 10

Arch Foundation Analysis

supports 101 & 141 will be combined into one footing. The reactions at joints 101 & 141 will be resolved to one point between them.

Due to symmetry the foundation for supports 113 and 153 will be identical.

Subject		Date
Computed by TJW	Checked by JGB	Sheet 2 of 1C

Reactions at Center of the foundation

$R_x = R_{x101} + R_{x141}$ $\quad R_z = R_{z101} + R_{z141}$

$R_y = R_{y101} + R_{y141}$

$M_x = M_{x101} + M_{x141} + R_{y101}(54'') - R_{y141}(54)$

$M_y = M_{y101} + M_{y141} - R_{x101}(54) + R_{x141}(54)$

$M_z = M_{z101} + M_{z141}$

Convert to CPGA INPUT

$P_x = -R_z$

$P_y = R_x$

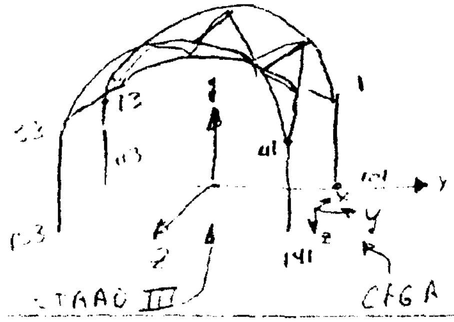
$P_z = R_y + \underbrace{(12' \times 10')2'(.15\ kcf)}_{\text{concrete foundation}} + \underbrace{[12'(10') - 2(2' \times 2')]3'(.12)}_{\text{overburden}}$

$P_z = R_y + 76.3$

$M_x = M_{z(STAAD)} / 12\ ^{in}/_{ft}$

$M_y = M_{x(STAAD)} / 12\ ^{in}/_{ft}$

$M_z = M_{y(STAAD)} / 12\ ^{in}/_{ft}$



REAC.XLS

REACTIONS FROM STAADIII COMMPUTER RUN

NODE	LOAD CASE	RX (kip)	RY (kip)	RZ (kip)	MX (k-in)	MY (k-in)	MZ (k-in)
101	1	-0.68	8.13	0.17	18.81	0.07	87.52
	2	22.90	-36.25	-9.11	-1309.95	-129.12	-3031.77
	3	-4.01	8.00	0.97	112.46	-0.49	524.00
	4	-5.96	0.00	2.90	394.00	10.30	834.32
	5	12.25	-20.12	-5.08	-784.67	-119.24	-1585.92
	6	24.17	-20.12	-10.88	-1572.67	-139.84	-3254.57
	7	-10.65	16.13	4.03	525.28	9.88	1445.85
	8	1 26	16.13	-1.77	-262.72	-10.72	-222.80
141	1	-0.68	8.13	-0.17	-18.81	-0.07	87.52
	2	-23.03	36.25	-7.83	-1082.26	-137.81	3047.15
	3	-4.01	8.00	-0.97	-112.46	0.49	524.00
	4	-5.96	0.00	-2.90	-394.00	-10.30	834.33
	5	-33.68	52.37	-11.86	-1607.54	-147.69	4493.00
	6	-21.76	52.37	-6.06	-819.53	-127.09	2824.35
	7	-10.65	16.13	-4.03	-525.28	-9.88	1445.85
	8	1.26	16.13	1.77	262.72	10.72	-222.81

REACTIONS AT THE CENTER OF THE FOUNDATION

LOAD CASE	RX (kip)	RY (kip)	RZ (kip)	MX (k-in)	MY (k-in)	MZ (k-in)
1	-1.36	16.26	0.00	0.00	0.00	175.04
2	-0.13	0.00	-16.94	-6307.21	-2747.15	15.38
3	-8.02	16.00	0.00	0.00	0.00	1048.00
4	-11.92	0.00	0.00	0.00	0.00	1668.65
5	-21.43	32.25	-16.94	-6306.67	-2747.15	2907.08
6	2.41	32.25	-16.94	-6306.66	-2747.15	-430.22
7	-21.30	32.26	0.00	0.00	0.00	2891.70
8	2.52	32.26	0.00	0.00	0.00	-445.61

CPGA INPUT (USE ONLY LOAD CASES 5, 6, 7, AND 8)

add 76.3 kips to vertical load for the weight of the foundation and overburden
convert from STAADIII coordinate system to CPGA

	PX (kip)	PY (kip)	PZ (kip)	MX (k-ft)	MY (k-ft)	MZ (k-ft)
1	0.00	-1.36	92.56	14.59	0.00	0.00
2	16.94	-0.13	76.30	1.28	525.60	-228.93
3	0.00	-8.02	92.30	87.33	0.00	0.00
4	0.00	-11.92	76.30	139.05	0.00	0.00
5	16.94	-21.43	108.55	242.26	525.56	-228.93
6	16.94	2.41	108.55	-35.85	525.56	-228.93
7	0.00	-21.30	108.56	240.98	0.00	0.00
8	0.00	2.52	108.56	-37.13	0.00	0.00

Subject: Des Moines Amplitheater		Date: Jan 92
Computed by: TJW	Checked by: JGB	Sheet 4 of

Pile Analysis

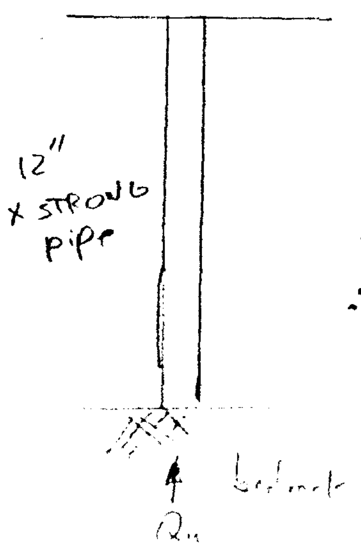
Piles will bear on rock ~ 40' below surface.
USE 12" X STRONG PIPE

$A = 19.2 \text{ in}^2$
$I = 362 \text{ in}^4$
$S = 56.7 \text{ in}^3$
$r = 4.33 \text{ in}$

Pile in Compression

Ref: EM 1110-2-2906 15 Jan 91
Design of Pile Foundations

From ED-6
bedrock $\phi = 51°$
bedrock $q_u = 3000$ psi



USE 12" Pipe piles

$A = 19.2 \text{ in}^2$
Drive to refusal
∴ STRUCTURAL Capacity of pile gov.

$f_a = 9.7$ ksi for A53

Q_{allow} = 10 ksi (19.2 in²) = 187 k

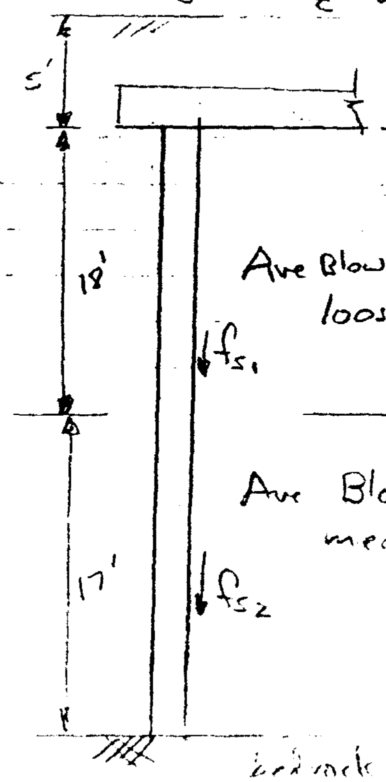
Subject: Des Moines Amplitheater		Date: Jan 92
Computed by: TJW	Checked by: JGB	Sheet 5 of 10

Piles in Tension

$$Q_{ult} = Q_{s\ Tension}$$

$$Q_s = A_s f_s$$

$$f_s = K_t \sigma_v' \tan(\delta)$$



bottom of pile cap EL 785

$D_c = 10B$
$= 10'$

Ave Blow count = 4
loose sand

$A_{s1} = 18\left(\frac{40}{12}\right) = 60$

Ave Blow count = 14
medium sand

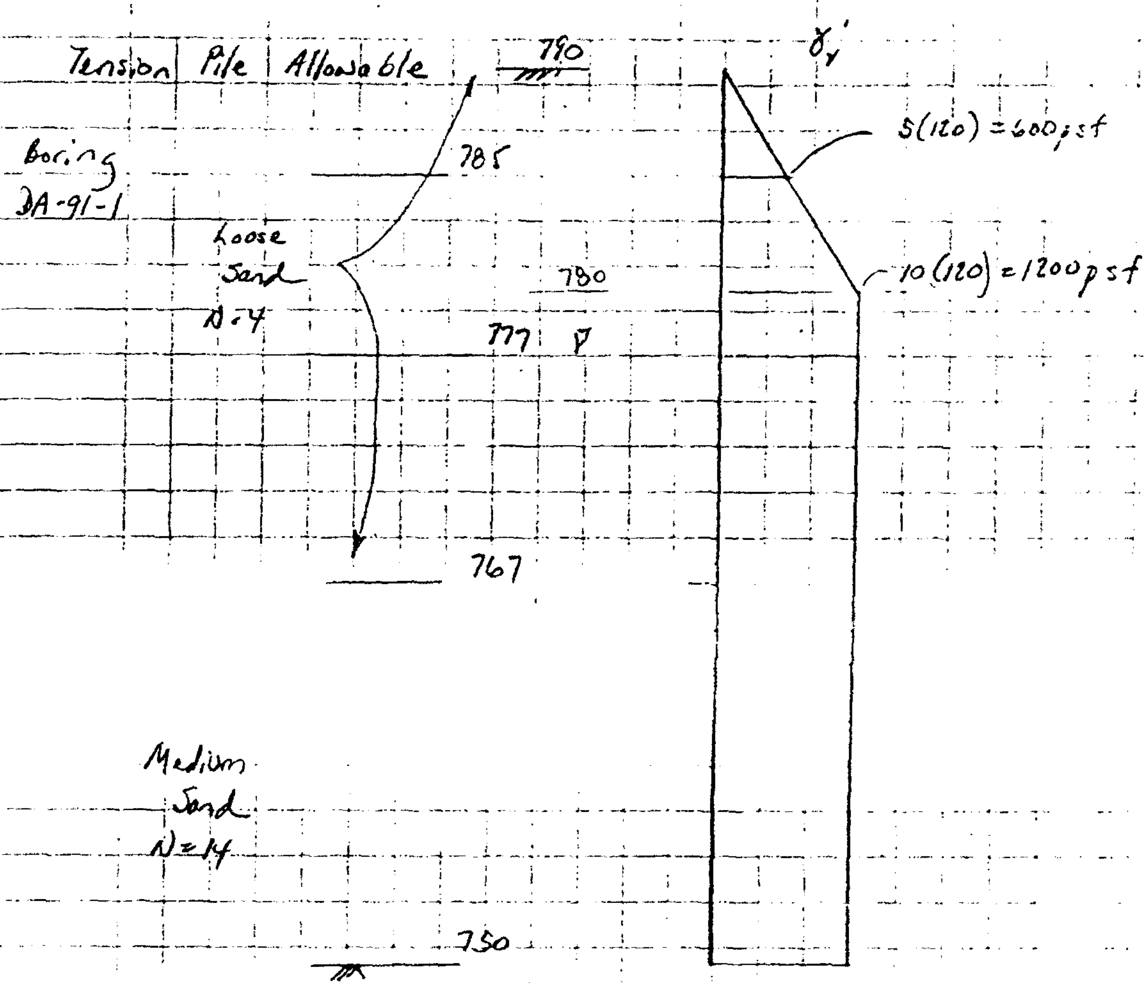
$D_c = 15B = 15'$

$A_{s2} = 17\left(\frac{40}{12}\right) = 57'$

NCR Form 381b
1 Aug 80

Plate D-45

Tension Pile Allowable



Use $K_{t_1} = 0.50$ Loose sand

$K_{t_2} = 0.60$ Medium sand

$\delta_1 = 0.67\,\phi$ Loose sand $\phi = 28^\circ$

$\delta_1 = 0.67(28^\circ) = 18.9^\circ$

Subject: Des Moines Amphitheater		Date: 3 Jul 92
Computed by: JGB	Checked by: TJW	Sheet 7 of 10

Tension Pile Allowable cont'd

$\delta = 0.75\,\phi$ medium to dense sand

$\delta = 0.75(30) = 22.5^\circ$

Loose Sand

$f_{s_1} = K_{t_1}\,\sigma'_v \tan \delta_1$

$= 0.50(600(5) + \tfrac{1}{2}(600)(5) + 1200(13)) \tan 18.8^\circ$

$= 0.50(3000 + 1500 + 15,600) \tan 18.8^\circ$

$= 0.50(20,100) \tan 18.8^\circ = 3421$ lb

Medium Sand

$f_{s_2} = K_{t_2}(\sigma'_{v_2}) \tan \delta_2$

$= 0.60(1200(17)) \tan 22.5^\circ = 5070$ lb

$Q_{s\,ult} = (f_{s_1} + f_{s_2})\,A_s = (3421 + 5070)\left(\frac{\pi(12.75)}{12}\right)$

$= 28,342$ lb $= 28.3^k$

Using FS = 2.25 EM 1110-2-2906 pg. 4-2

$Q_{s\,all} = \frac{28.3}{FS} = \frac{28.3}{2.25} = 12.6^k$

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Subject DES MOINES AMPHITHEATER		Date 31 JUL 92
Computed by JGB	Checked by TJW	Sheet 8 of 10

Tension Pile Allowable

$$P_{allw} = Q_{sallw} + wt.\ pile$$

$$= 12.6 + \frac{65.42\,(35)}{1000} = 12.6 + 2.3$$

$$= 14.9^{k}$$

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Plate D-48

Subject DES MOINES AMPHITHEATER		Date 31 JUL 92
Computed by JGB	Checked by TJW	Sheet 9 of 10

n_h : constant of horizontal subgrade reaction

Ref - Basic Pile Group Behavior
pg. D4

$$n_h = \frac{A\gamma}{1.35} = \frac{100(120)}{1.35} = 8889 \frac{lb}{ft^3} = \frac{8889}{(1000)(1728)} = .005 \frac{k}{in^3}$$

$AC = 187^k$ (see sheet 6)

$AT = 14.9^k$ (see sheet)

Check pipe for compact requirements

AISC pg 5-36

$$\frac{D}{t} = \frac{12.75}{.5} = 25.5 < \frac{3300}{F_y} = 91.7$$

∴ 12" E.S. Pipe compact

Use $F_b = \frac{5}{9} F_y = \frac{5}{9}(35) = 19.4$ ksi EM 1110-2-2906 pg. 4-3

$F_a = \frac{1}{2} F_y = \frac{1}{2}(35) = 17.5$ ksi

$ACC = F_a A = 17.5(19.2) = 336^k$

$ATT = F_a A = 17.5(19.2) = 336^k$

$AM1 = AM2 = F_b S = 19.4(56.7) = 1100^{"k}$

NCR Form 381b
1 Aug 80

```
1000 DES MOINES AMPLITHEATER - INPUT FILE -
1010 ARCH FOUNDATION USING 9 - 12 PIPE PILES
1030 PRO 29000 362 362 19.2 1 0 ALL
1040 SOI NH .005 TIP 35 0 ALL
1050 FIX ALL
1060 ALLOW R 187 14.9 336 336 1100 1100 ALL
1070 PILE 1 -3.5 -4.5 0  2 -3.5 0 0  3 -3.5 4.5 0
1071 PILE 4 0 -4.5 0   5 0 0 0   6 0 4.5 0
1072 PILE 7 3.5 -4.5 0   8 3.5 0 0   9 3.5 4.5 0
2100 LOAD 1 16.94 -21.43 108.6 242.3 525.6 -228.9
2110 LOAD 2 16.94 2.41  108.6 -35.85 525.6 -228.9
2120 LOAD 3 0 -21.3 108.5 241.0 0 0
2130 LOAD 4 0 2.52 108.56 -37.13 0 0
2200 FOUT 1 2 3 4 5 6 7 OUT0727
```

Plate D-50

```
**********************************
* CORPS PROGRAM  #  X0080        *   CPGA - CASE PILE GROUP ANALYSIS PROGRAM
* VERSION NUMBER # 1992/02/26    *   RUN DATE 31-JUL-1992    RUN TIME  9.33.36
**********************************

DES MOINES AMPLITHEATER - INPUT FILE
ARCH FOUNDATION USING 9 - 12 PIPE PILES

THERE ARE     9 PILES AND
              4 LOAD CASES IN THIS RUN.

ALL PILE COORDINATES ARE CONTAINED WITHIN A BOX
                                          X           Y           Z
                                        -----       -----       -----
WITH DIAGONAL COORDINATES = (          -3.50 ,     -4.50 ,       .00 )
                            (           3.50 ,      4.50 ,       .00 )

*******************************************************************************

         PILE PROPERTIES AS INPUT

       E            I1            I2            A            C33          B66
      KSI          IN**4         IN**4        IN**2
   .29000E+05   .36200E+03   .36200E+03   .19200E+02   .10000E+01   .00000E+00

THESE PILE PROPERTIES APPLY TO THE FOLLOWING PILES -

    ALL
```

Plate D-51

****

SOIL DESCRIPTIONS AS INPUT

NH	ESOIL K/TN**3	LENGTH	L FT	LU FT
	.[illegible]000E-02	T	.35000E+02	.00000E+00

THIS SOIL DESCRIPTION APPLIES TO THE FOLLOWING PILES -

ALL

****

PILE GEOMETRY AS INPUT AND/OR GENERATED

NUM	X FT	Y FT	Z FT	BATTER	ANGLE	LENGTH FT	FIXITY
1	-3.50	-4.50	.00	V	.00	35.00	F
2	-3.50	.00	.00	V	.00	35.00	F
3	-3.50	4.50	.00	V	.00	35.00	F
4	.00	-4.50	.00	V	.00	35.00	F
5	.00	.00	.00	V	.00	35.00	F
6	.00	4.50	.00	V	.00	35.00	F
7	3.50	-4.50	.00	V	.00	35.00	F
8	3.50	.00	.00	V	.00	35.00	F
9	3.50	4.50	.00	V	.00	35.00	F

						315.00	

****

APPLIED LOADS

LOAD CASE	PX K	PY K	PZ K	MX FT-K	MY FT-K	MZ FT-K
1	16.9	-21.4	108.6	242.3	525.6	-228.9
2	16.9	2.4	108.6	-35.9	525.6	-228.9
3	.0	-21.3	108.5	241.0	.0	.0
4	.0	2.5	108.6	-37.1	.0	.0

****

ORIGINAL PILE GROUP STIFFNESS MATRIX

.25910E+03	.00000E+00	.00000E+00	.00000E+00	.17640E+05	.00000E+00
.00000E+00	.25910E+03	.00000E+00	-.17640E+05	.00000E+00	.00000E+00
.00000E+00	.00000E+00	.11931E+05	.00000E+00	-.14552E-10	.00000E+00
.00000E+U0	-.17640E+05	.00000E+00	.25131E+08	.00000E+00	.29104E-10
.17640E+05	.00000E+00	-.14552E-10	.00000E+00	.15968E+08	.00000E+00
.00000E+00	.00000E+00	.00000E+00	.29104E-10	.00000E+00	.80841E+06

LOAD CASE 1. NUMBER OF FAILURES = 0. NUMBER OF PILES IN TENSION = 3.

LOAD CASE 2. NUMBER OF FAILURES = 0. NUMBER OF PILES IN TENSION = 3.

LOAD CASE 3. NUMBER OF FAILURES = 0. NUMBER OF PILES IN TENSION = 0.

LOAD CASE 4. NUMBER OF FAILURES = 0. NUMBER OF PILES IN TENSION = 0.

Plate D-53

****

PILE CAP DISPLACEMENTS

LOAD CASE	DX IN	DY IN	DZ IN	RX RAD	RY RAD	RZ RAD
1	.4162E-01	-.7859E-01	.9102E-02	.6054E-04	.3490E-03	-.3398E-02
2	.4162E-01	.8544E-02	.9102E-02	-.1112E-04	.3490E-03	-.3398E-02
3	-.6101E-18	-.7810E-01	.9094E-02	.6025E-04	.8961E-20	-.2169E-20
4	-.6104E-18	.8946E-02	.9099E-02	-.1145E-04	.8966E-20	.4122E-21

****

PILE FORCES IN LOCAL GEOMETRY

M1 & M2 NOT AT PILE HEAD FOR PINNED PILES
* INDICATES PILE FAILURE
\# INDICATES CBF BASED ON MOMENTS DUE TO
(F3*EMIN) FOR CONCRETE PILES
B INDICATES BUCKLING CONTROLS

NO PILES OVERSTRESSED

****

PILE FORCES IN GLOBAL GEOMETRY

LOAD CASE - 1

PILE	PX K	PY K	PZ K	MX IN-K	MY IN-K	MZ IN-K
1	-3.4	1.7	27.2	-112.7	-203.0	.0
2	1.9	1.7	31.5	-112.7	156.7	.0
3	7.2	1.7	35.8	-112.7	516.3	.0
4	-3.4	-2.4	7.7	167.1	-203.0	.0
5	1.9	-2.4	12.1	167.1	156.7	.0
6	7.2	-2.4	16.4	167.1	516.3	.0
7	-3.4	-6.5	-11.7	446.8	-203.0	.0
8	1.9	-6.5	-7.4	446.8	156.7	.0
9	7.2	-6.5	-3.0	446.8	516.3	.0

LOAD CASE - 2

PILE	PX K	PY K	PZ K	MX IN-K	MY IN-K	MZ IN-K
1	-3.4	4.4	32.3	-298.8	-203.0	.0
2	1.9	4.4	31.5	-298.8	156.7	.0
3	7.2	4.4	30.7	-298.8	516.3	.0
4	-3.4	.3	12.9	-19.1	-203.0	.0
5	1.9	.3	12.1	-19.1	156.7	.0
6	7.2	.3	11.3	-19.1	516.3	.0
7	-3.4	-3.8	-6.6	260.6	-203.0	.0
8	1.9	-3.8	-7.4	260.6	156.7	.0
9	7.2	-3.8	-8.2	260.6	516.3	.0

LOAD CASE - 3

PILE	PX K	PY K	PZ K	MX IN-K	MY IN-K	MZ IN-K
1	.0	-2.4	7.7	166.0	.0	.0
2	.0	-2.4	12.1	166.0	.0	.0
3	.0	-2.4	16.4	166.0	.0	.0
4	.0	-2.4	7.7	166.0	.0	.0
5	.0	-2.4	12.1	166.0	.0	.0
6	.0	-2.4	16.4	166.0	.0	.0
7	.0	-2.4	7.7	166.0	.0	.0
8	.0	-2.4	12.1	166.0	.0	.0
9	.0	-2.4	16.4	166.0	.0	.0

LOAD CASE - 4

PILE	PX K	PY K	PZ K	MX IN-K	MY IN-K	MZ IN-K
1	.0	.3	12.9	-20.0	.0	.0
2	.0	.3	12.1	-20.0	.0	.0
3	.0	.3	11.2	-20.0	.0	.0
4	.0	.3	12.9	-20.0	.0	.0
5	.0	.3	12.1	-20.0	.0	.0
6	.0	.3	11.2	-20.0	.0	.0
7	.0	.3	12.9	-20.0	.0	.0
8	.0	.3	12.1	-20.0	.0	.0
9	.0	.3	11.2	-20.0	.0	.0

Subject Des Moines Amplitheater		Date Jan 92
Computed by TJW	Checked by JOB	Sheet 10 of 10

FROM CPGA Output -

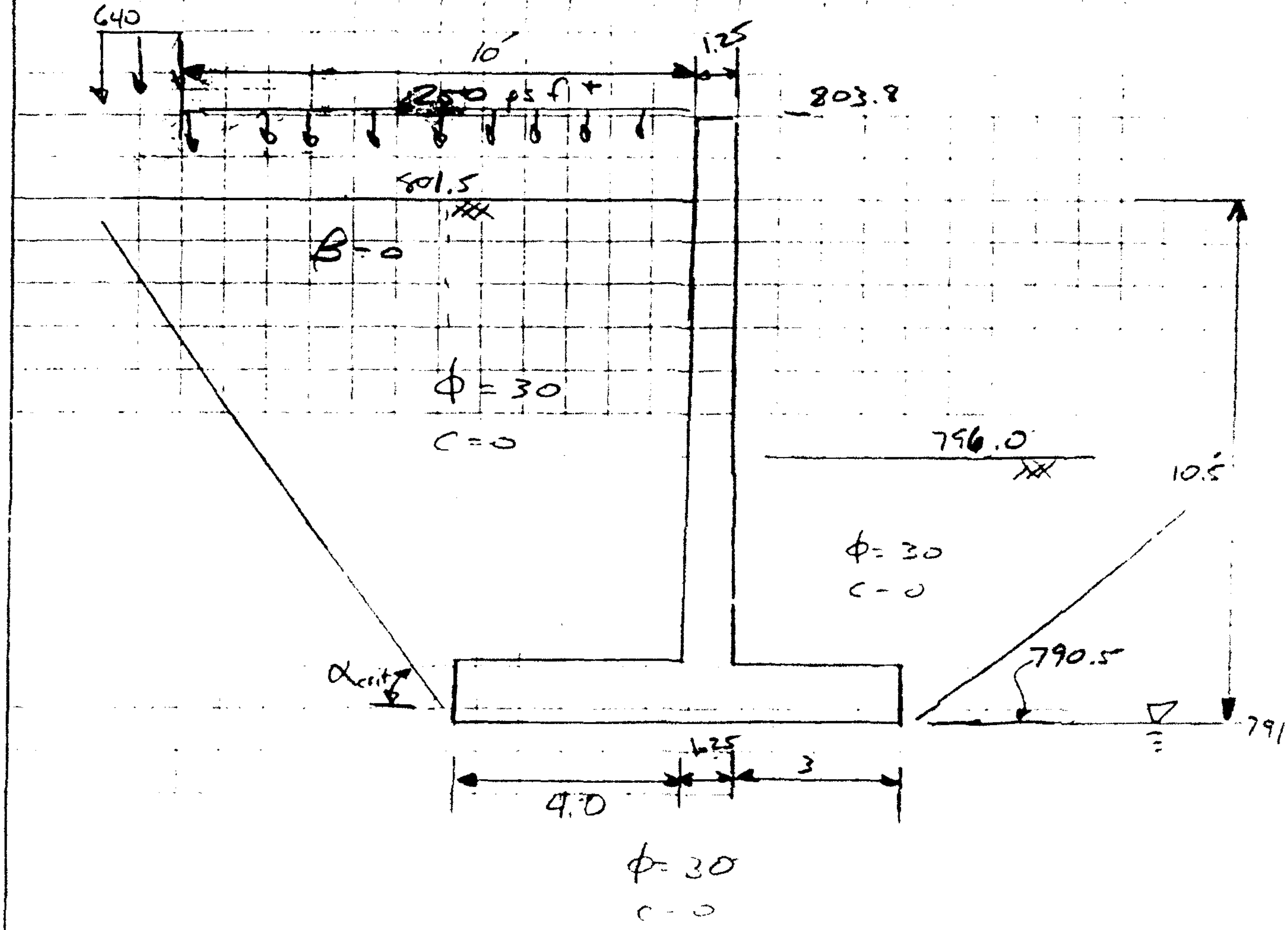
All piles ok for All Load Cases

NCR Form 381b
1 Aug 80

Subject: Des Moines Amphitheater		Date: Nov 91
Computed by: TJW	Checked by: MW	Sheet 1 of 9

Retaining Wall

use Coulomb Earth Pressures



$C_d = 0$

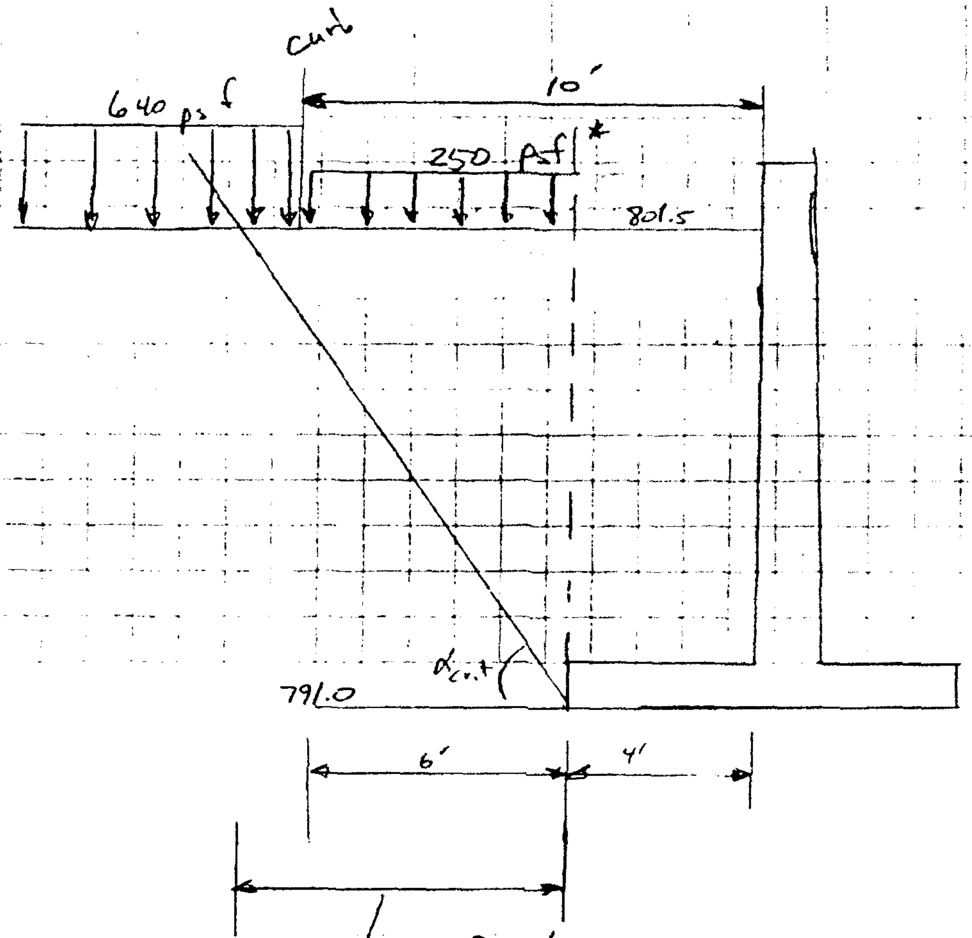
$\phi_d = \tan^{-1}(.667 \tan 30) = 21.05°$

use $\phi_d = 21$

$\alpha_{crit} = 45 + \phi_d/2 = 55.5°$

Plate D-58

Subject Des Moines Amphitheater		Date Nov 91
Computed by TJW	Checked by MW	Sheet 2 of



L 10.5/tan(55.5) = 7.22'

Total Surcharge on active wedge
= 1.22(640) + 6(250) = 2281 #/ft.

Ave surcharge = 2281/7.22 = 316 psf

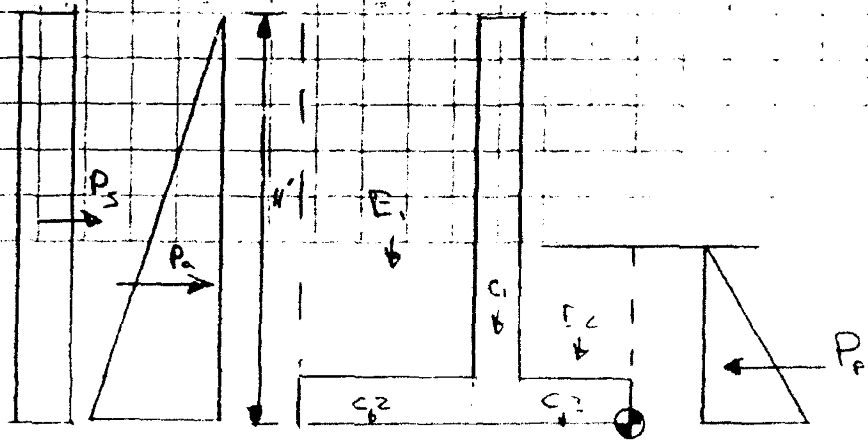
use Surcharge = 320 psf
for analysis

do not include surcharge on structure for
overturning or sliding analysis

Subject Des Moines Amphitheater		Date Nov 91
Computed by TJW	Checked by MW	Sheet 3 of 9

$$K_a = \frac{1 - \tan(21)\cot(55.5)}{1 + \tan(21)\tan(55.5)} = 0.472$$

$$K_p = 1/K_a = 2.12$$



Item		Force (↓ +)	Force (← +)	arm	moment
C1	1.25(13.3)(150) =	+2494		3.625	+9040
C2	4(1.5)(150) =	+900		6.25	+5625
C3	3(1.5)(150) =	+675		1.5	+1013
E1	(9.0)4(120) =	+4320		6.25	+27000
E2	(3.5)(3)(120) =	+1260		1.5	+1,890
P_s	(320)(.472)(10.5) =		−1586	5.25	−8,326
P_a	$\frac{1}{2}(120)(.472)(10.5)^2$ =		−3122	10.5/3	−10,928
P_p	$(.5)\frac{1}{2}(120)(2.12)(5)^2$ =		+1590	5/3	+2650
		+9649	−3118		27,964

use ½ of available passive resistance

Subject Des Moines Amphitheater	Date Nov 91
Computed by TJW · Checked by MW	Sheet 4 of

$\bar{x} = \Sigma M / \Sigma V = 27964 / 9649 = 2.90$

$B/3 = 2.75'$

$\therefore$ Since $\bar{x} > B/3$ 100% of base is in Compression

OK

$e = \frac{8.25}{2} - 2.90 = 1.22'$

Sliding

use single wedge

use FS = 1.5

$T = \frac{N \tan\phi}{FS}$ $\phi = 30°$

$N' = 9649^{\#}/\text{ft}$

$T = \frac{9646 \tan 30°}{1.5} = 3713^{\#}$

$\Sigma P = 3118$ OK $T > \Sigma P$

NCR Form 381b
1 Aug 80

Subject: Des Moines Amphitheater		Date: Nov 91
Computed by: TJW	Checked by: MW	Sheet 5 of 9

Foundation Analysis

$\phi = 30 \qquad C = 0$

$V = 9649 \ \#/ft$

$B = 8.25'$

$e = 1.22$

$\bar{B} = B - 2e = 5.81$

$q_0 = 5(120) = 600 \ psf$

$N_q = 18.40$

$N_\gamma = 15.67$

$E_{qd} = E_{\gamma d} = 1 + .1\left(\frac{5}{5.81}\right) \tan^2\left(45 + \frac{30}{2}\right) = 1.26$

$\delta = \tan^{-1}(3118 / 9649) = 17.91$

$E_{qi} = \left(1 - 17.91/90\right)^2 = 0.64$

$E_{\gamma i} = \left(1 - 17.91/30\right)^2 \quad 0.162$

$Q = 5.81\left[0 + 600(18.40)(1.26)(.64) + \frac{1}{2}(15.67)(125)(5.81)(1.26)(.162)\right]$

$= 54821$

$FS = 54821 / 9649 \quad \boxed{5.68}$

NCR Form 3616
1 Aug 80

Plate D-62

Subject: Des Moines Amphitheater		Date: Nov 97
Computed by: TJW	Checked by: MW	Sheet 6 of 0

Foundation settlement

Approx 15 c.f/ft of earth is being removed from above the toe

$(15)(120\,pcf) = 1800\ \#/ft$

Added weight = $250\,psf\,(4) = 1000\ \#/ft$ (temporary load)

$2.3\,(1.5)(150) = 518\ \#/ft$ (Top of wall)

$(150 - 120\,pcf)(9(1.5) + 8.5(1.5)) = 788\ \#/ft$

if the temp. surcharge is included approx. 500 #/ft of wall is being added.

if surcharge is not included, there is a net reduction on soil stress resulting in no settlement.

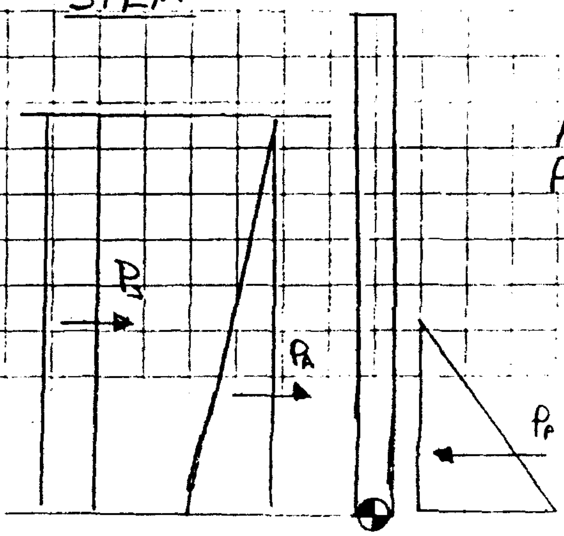
∴ settlement OK

NCR Form 381b
1 Aug 80

Subject: Des Moines Amphitheater		Date: Nov 91
Computed by: TJW	Checked by: MW	Sheet 7 of 9

DESIGN T-WALL MEMBERS

STEM



	Force	Arm	Moment
$P_s = .47(320)(9) =$	$1359^{\#}$	4.5	6116
$P_A = (.472)\frac{1}{2}(120)9^2 =$	2294	3	6882
$P_p = -2.12(\frac{1}{2})(120)(3.5)^2 =$	-1558	1.17	-1823

$V_{max} = 2095^{\#}$ $\quad M_{max} = 11{,}175^{\#}\text{ft}$

Check shear

$h = 15''$ $\quad d = 12''$

$$V_c = 2\sqrt{4000}\,12(12) = 18{,}215^{\#}$$

by inspection Shear OK

$$M_u = 1.7(11{,}175) = 18{,}998 \Rightarrow 19000^{\#}\cdot\text{ft}$$

$$\frac{M_u}{f'_c b d^2} = \frac{19000}{.9(4000)(1)(15)^2} = 0.03665$$

$$\omega = 0.0373$$

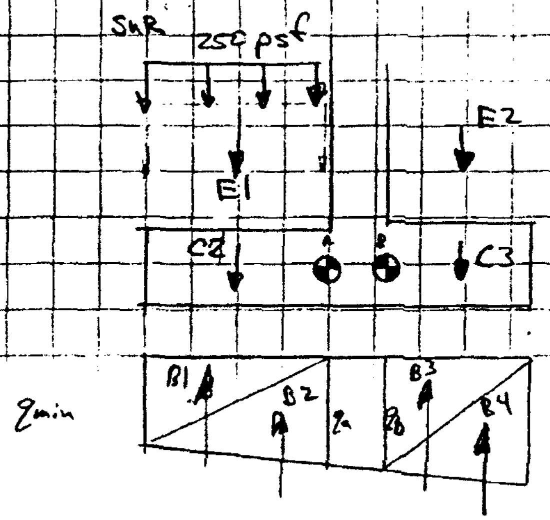
$$\rho = 0.0373\frac{4}{60} = 0.00249$$

$$A_{s\,req} = 0.00249(12)(12) = 0.359\ \text{in}^2/\text{ft}$$

use #5 @ 10 $\quad A_s = 0.372\ \text{in}^2/\text{ft}$

Subject	Des Moines Amphitheater	Date	Nov 91
Computed by TJW	Checked by MW	Sheet 8 of	

BASE DESIGN



$e = 1.22$
$B = 8.25$
$V = 9649$

$q_{max} = \frac{9649}{8.25}\left(1 + \frac{6(1.22)}{8.25}\right)$

$= 2207$ psf

$q_{min} = \frac{9649}{8.25}\left(1 - \frac{6(1.22)}{8.25}\right)$

$= 132$ psf

$q_a = 132 + \frac{4}{8.25}(2207 - 132) = 1138$ psf

$q_b = 2207 - \frac{3}{8.25}(2207 - 132) = 1452$ psf

HEEL DESIGN

	Force	Arm	Moment
SUR 250 (4)	1000	2	2000
E1 (from overturning Analysis) =	4320	2	8640
C2 " " " " =	900	2	1800
$B1 = -\frac{1}{2}(362)(4)$ =	-264	8/3	-704
$B2 = -\frac{1}{2}(1146)(4)$ =	-2276	4/3	-3035

$V_{max} = 3680$ # $M_{max} = 8701$

Since Heel Moment is less than stem Moment use same reinforcing

$A_s = 0.372$

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1 Aug 80

Subject Des Moines Amphitheater		Date Nov 96
Computed by TJW	Checked by MW	Sheet 9 of 9

TOE DESIGN

		Force	arm	moment
E2	from overturning	-1260	1.5	-1890
C3	" "	-675	1.5	-1013
B3	$\frac{1}{2}(3)(1452)$	2178	1	2178
B4	$\frac{1}{2}(3)(2207)$	3311	2	6622
		3554 #		5897 #-ft

$$M_u = 1.7(5897) = 10025 \text{ \#-ft}$$

$$\frac{M_u}{f'_c b d^2} = \frac{10025}{.9(4000)(1)(14)^2} = 0.0142$$

$$\omega = 0.0143$$

$$\rho = 0.0143 \; 4/60 = 0.000953$$

use $4/3\,\rho$ $\quad A_{s\,req} = 4/3(.000953)(14)(12)$

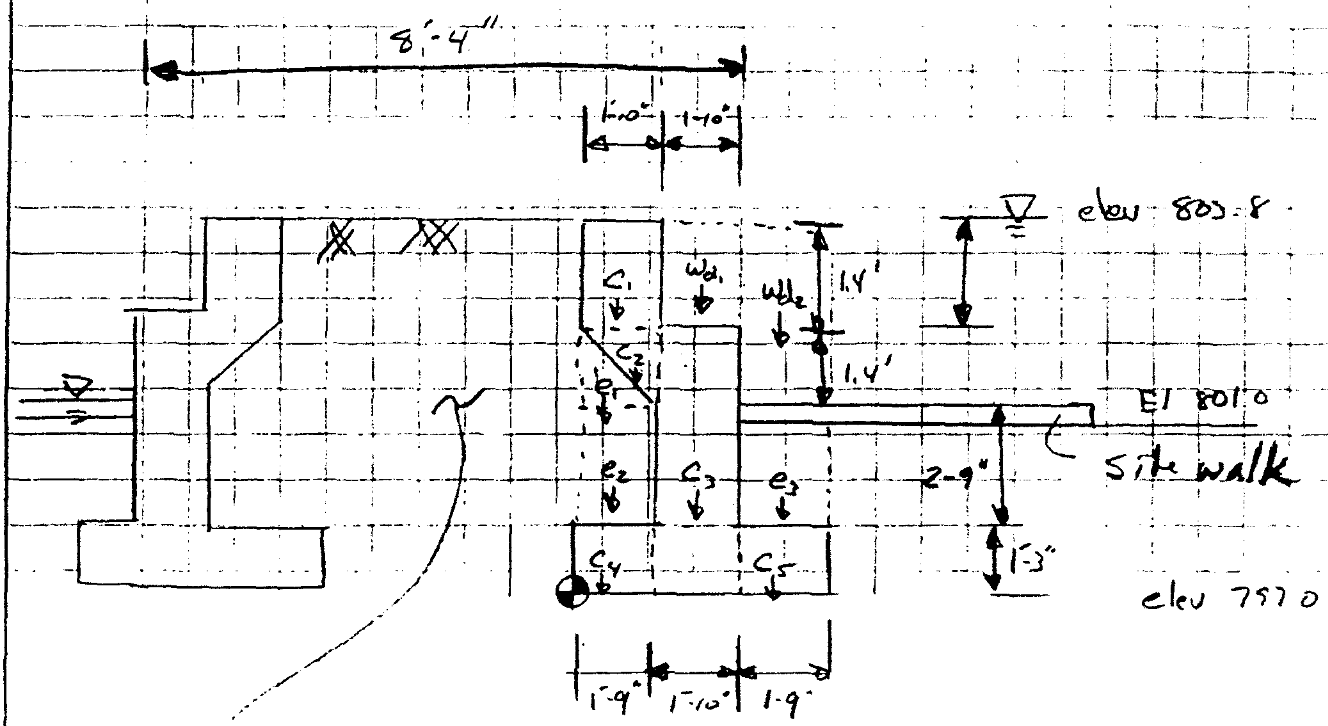
$$= .213$$

use #4 @ 10

$A_s =$ 0.24 in/ft

NCR Form 381b
1 Aug 80

Subject Des Moines Amplitheater		Date Nov. 91
Computed by TJW	Checked by MW	Sheet 1 of 2



Use At rest soil pressure on passive side

Use $\phi = 27^\circ$ for all soil

SMF = 2/3

$$\phi_d = \tan^{-1}\left(\frac{2}{3}\tan 27\right) = 18.76^\circ$$

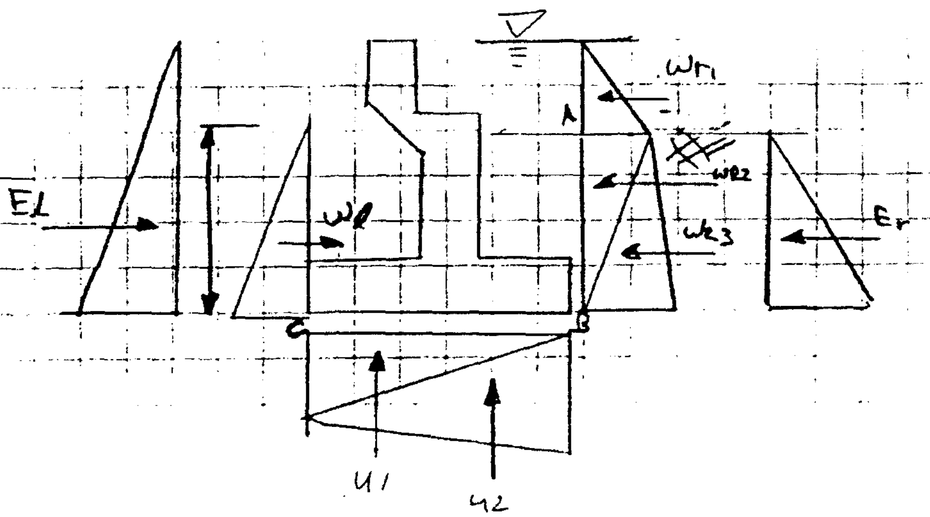
$$k_a = \tan^2\left(45 - \frac{18.76}{2}\right) = 0.513$$

Use at rest pressure on passive side

$$k_o = 1 - \sin\phi$$
$$= 1 - \sin 27$$
$$= 0.546$$

use unfactored ϕ
(more conservative)

Subject Des Moines Amplitheater		Date Nov 91
Computed by TJW	Checked by MW	Sheet 2 of 4



See previous page for gravity loads

Des Moines Amphitheater planter box/flood wall

toe width	1.75 ft		water el at heel	803.8	ft
heel width	1.75 ft		water el at toe	801	ft
stem width	1.833 ft		(other side of planter)		
total base width	5.333 ft		earth el at heel	801	ft
base thickness	1.25 ft		earth el at toe	803.8	ft
base elev	797 ft				
top of wall elev	803.8 ft				

gravity loads	Force	Arm	Moment
c1 = (1.833)(1.4)(150)	384.93	0.8335	320.8391
c2 = ½(1.833)(1.4)(150)	192.465	1.139	219.2176
c3 = (5.4)(1.833)(150)	1484.73	2.6665	3959.032
c4 (1.75)(1.25)(150)	328.125	0.875	287.1093
c5 (1.75)(1.25)(150)	328.125	4.458	1462.781
wd1 (1.4)(1.833)(62.5)	160.3875	2.6665	427.6732
wd2 (1.75)(2.8)(62.5)	306.25	4.458	1365.262
e1 ½(1.75)(1.40)(120)	147	0.583333	85.75
e2 (2.75)(1.75)(120)	577.5	0.875	505.3125
e3 2.75(1.75)(120)	577.5	4.458	2574.495
	=======		=======
	4487.012		11207.47

Head Diff = 803.8 - 801 = 2.8

flow path = 8.33 + 2(1.75)+2(4) = 19.83 (no crack at heel)

gradient 2.8/19.833 0.141200

pressure at A	175	psf	= 2.8(62.5)
pressure at B	389.6999	psf	= 175+(1-.1412)(4)(62.5)
pressure at C	342.6361	psf	= 389.70 - .1412(5.333)62.5
water height @C	5.482178	ft	= 342.6/62.5

Uplift	Force	Arm	Moment
u1 = -½(342.6)(5.33) =	-913.639	1.777666	-1624.14
u2 = -½(389.7)(5.33) =	-1039.13	3.555333	-3694.47
	=======		=======
	-1952.77		-5318.61

Lateral loads	Force	Arm	Moment
wr1 = $-\frac{1}{2}(2.8)^2 62.5$ =	-245	4.933333	-1208.67
wr2 = $-\frac{1}{2}(4)(175)$ =	-350	2.666667	-933.333
wr3 = $-\frac{1}{2}(4)389.7$ =	-779.4	1.333333	-1039.2
wl = $-\frac{1}{2}(5.48)(342.6)$ =	939.1963	1.827393	1716.281
er (active) $\frac{1}{2}(.513)576(4)^2$	-235.98	1.333333	-314.64
el (at rest) = $\frac{1}{2}(.546)(525)(6.8)^2$ =	725.8524	2.266667	1645.265
	========		========
	54.66879		-134.294

SUM OF VERTICAL FORCES	2534.238
SUM HORIZONTAL FORCES	54.66879
SUM OF MOMENTS	5754.562

Xbar= 2.270727
b/3= 1.777667

OK - Resultant within middle 1/3
No Sliding Analysis is needed since the net lateral force is positive even when at-rest pressures are used

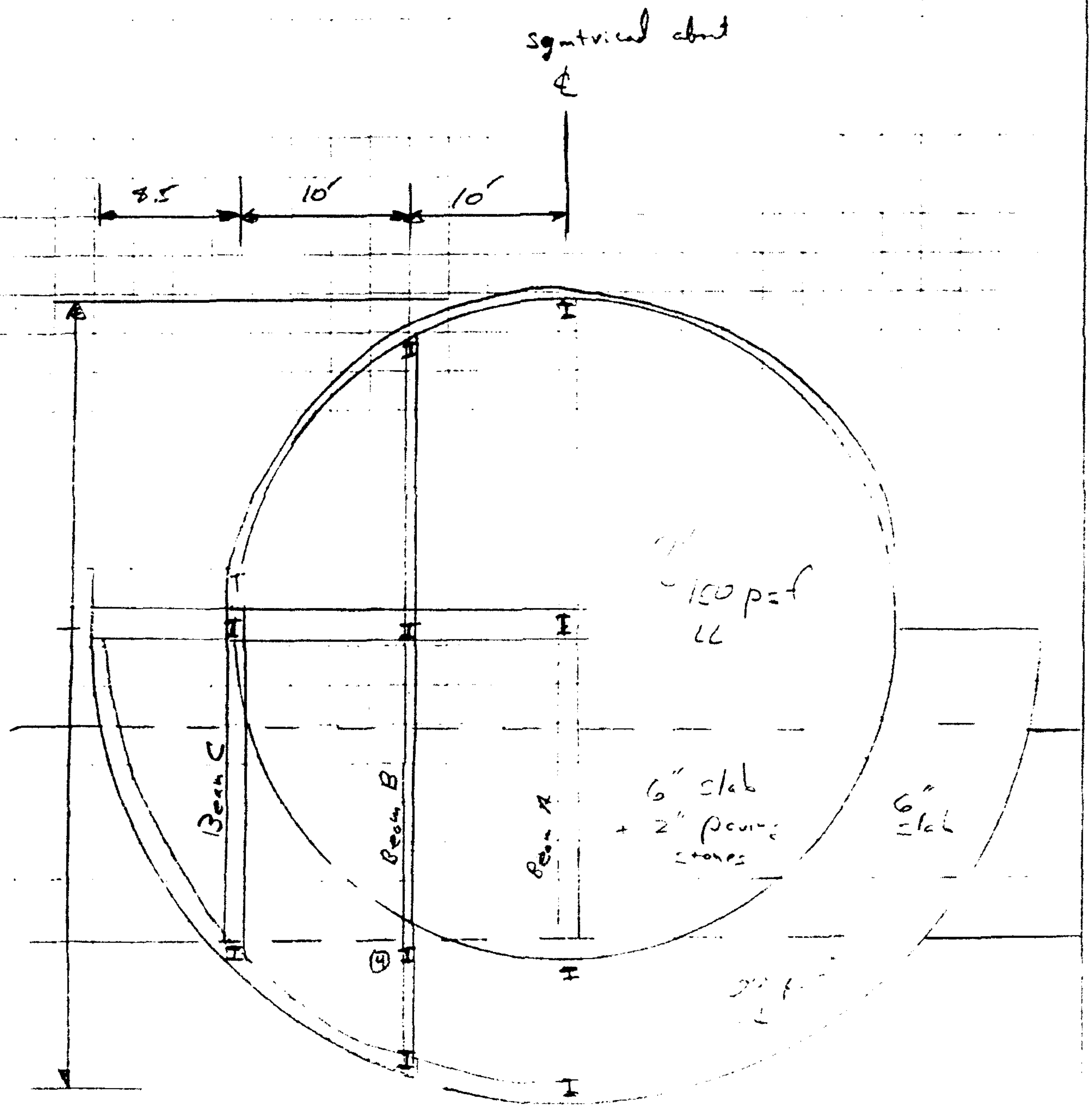
Subject: Des Moines Amphitheater	Date: Nov 91
Computed by: TJW / Checked by: MW	Sheet 1 of 5

STAGE DESIGN

Loads were taken from ASCE Minimum Loads for Building & other structures. STage must span over existing sewer and not place any load on it. Use a Live load of 150 psf on stage and 100 psf on walk area.

NCR Form 381b
1 Aug 80

Subject Des Moines Amphitheater		Date Nov. 91
Computed by TJW	Checked by MW	Sheet 2 of 12



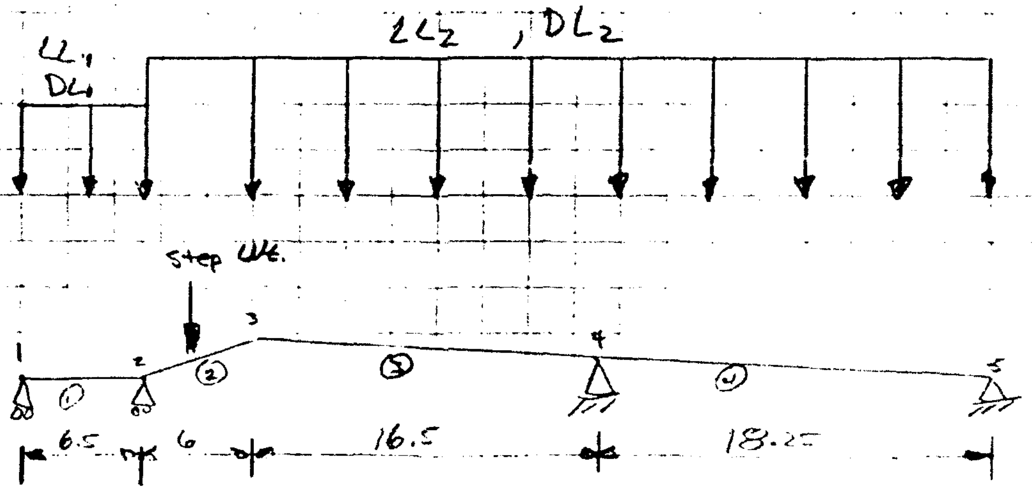
NCR Form 381b
1 Aug 80

Subject: Des Moines Amphitheater		Date: Nov. 91
Computed by: TJW	Checked by: MW	Sheet 3 of

BEAM A

Assume slab spans one way between beams

Assume 6" slab



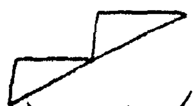
$LL_1 = 100^* psf\,(10') = 1000\ p/f = 1k/f$

$DL_1 = .5'(10')(150\ pcf) = 750\ p/f$ (slab wt)

$+\ 15''(24''-6'')(150)/144 = 281\ p/f$ (beam wt)

$1031\ p/f$

Dead Wt from steps (make a concentrated load in middle of steps)



Step wt = $10'\left[2\left(\tfrac{1}{2}\right)(14'')(20'')(150)/144\right] = 2920^{\#}$

use 5^k

since step curves

NCR Form 1 Aug 80 381b

Subject: Des Moines Amphitheater		Date: Nov 91
Computed by: TJW	Checked by: MW	Sheet 4 of 12

$LL_2 = 150 \text{ psf } (10') = 1500 \text{ p/f} = 1.5 \text{ k/f}$

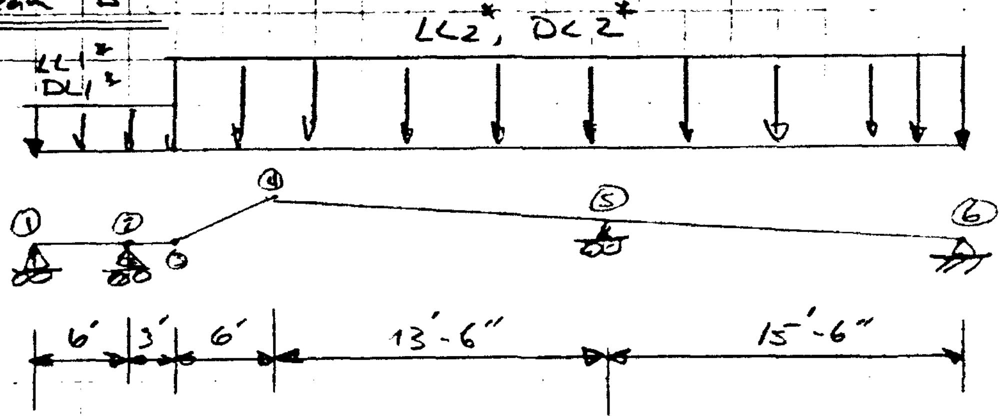
$DL_2 = \frac{1}{12}(8'')(10')(150) = 1000 \text{ p/f}$ (slab)

$+ \quad 281$ (beam)

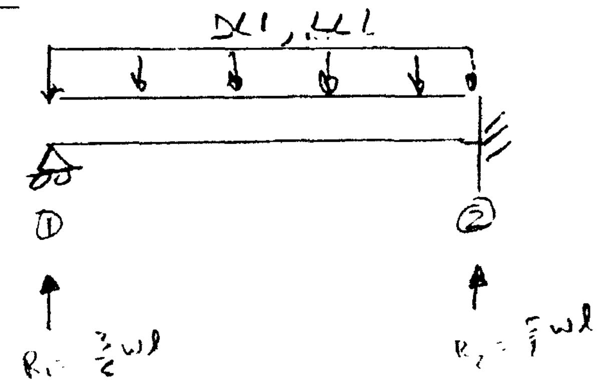
1281 p/f

$= 1.281 \text{ k/f}$

Beam "B"



BEAM C



* Same as BEAM "A"

Subject: Des Moines Amphitheater			Date: July 92
Computed by: MW	Checked by: TJW		Sheet 5 of 17

RESULTS FROM CFRAME run

$M_u^{(-)} = -2349$ k-in @ Joint 4 member 3

$M_u^{(+)} = +1348$ k-in member 3

Neg steel

$M_u = 2349$ k-in

$$\frac{M_u}{f'_c b d^2} = \frac{2349}{0.9(4)(15)(21)^2} = 0.0986$$

$\omega = 0.1051$

$\rho = 0.1051(4/60) = 0.0070$

A_s reqd $= 0.007(21)(15)$
$= 2.21$ in^2

Use 3-#8 $A_s = 2.37$ in^2

NCR Form 381b
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Plate D-75

Subject: Des Moines Amphitheater	Date: July 92
Computed by: MW / Checked by: TJW	Sheet 6 of 12

Positive steel

$Mu(+) = 1348$

$$\frac{Mu}{f'_c b d^2} = \frac{1348}{0.9(4)(15)(21)^2} = 0.0566$$

$\omega = 0.0586$

$\rho = 0.0586\left(\frac{4}{60}\right) = .00391$

$As\ req'd = 0.00391(15)(21)$
$= 1.23\ in^2$

USE 3-#6
$As = 1.32\ in^2/ft$

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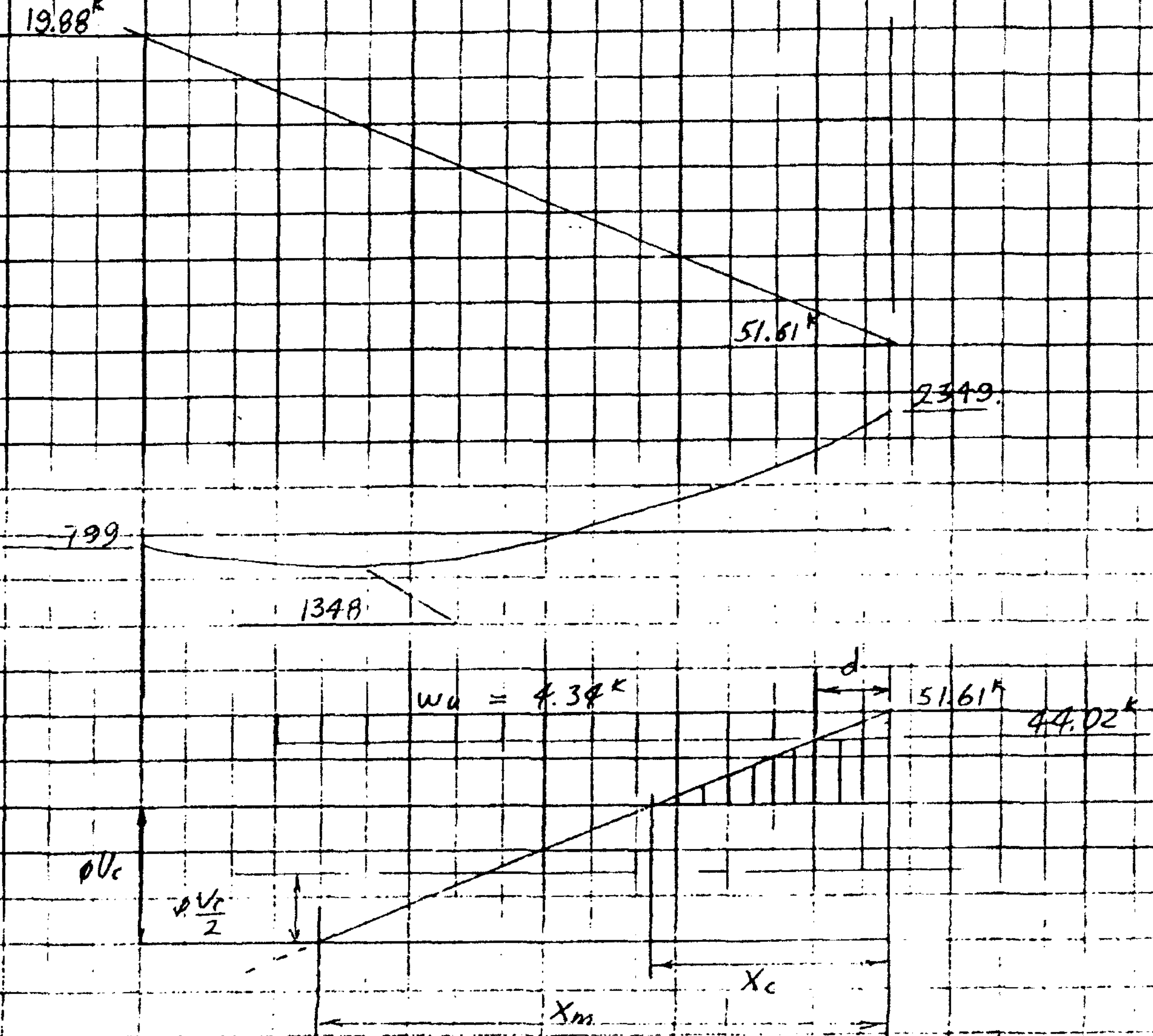
Subject: Des Moines Amphitheater | Date: July 92
Computed by: MW | Checked by: TJW | Sheet 7 of 17

Shear



$w_u = 1.4(1.281) + 1.7(1.5) = 4.34$ klf

@ support: $V_u = 51.61^k$

@ distance d from support:

$V_u = 51.61 - 4.34\frac{21}{12} = 44.02^k$

Subject: Des Moines Amphitheater		Date: July 92
Computed by: MW	Checked by: TJW	Sheet 8 of 12

$\phi V_c = \phi 2\sqrt{f'_c}\, b_w d$

$= 0.85(2)\sqrt{4000}(15)(21) = 33,868^{\#} = 33.87^{k}$

$x_c = (51.61 - 33.87)/4.34 = 4.1'$

$x_m = \left(51.61 - \frac{33.87}{2}\right)/4.34 = 8.0'$

$s_{req'd} = \phi A_v f_y d / (V_u - \phi V_c)$

Assuming #3 U-stirrups ($A_v = 0.22\ in^2$)

$s_{req'd} = 0.85(.22)(60)(21)/(\text{[illegible]} - 33.8\text{[illegible]})$

$= 23.21''$

@ $x = d + [(x_c - d)/2]$

$= 2.93'$

$s(req'd) = 23.21/(1/2) = 46.42'' > 24''$ $s = 24''$

$s_{max} \le d/2 = \frac{21}{2} = 10.5$ say $10''$

$s_{max} = A_v f_y / 50 b_w = .22(60,000)/50(15) = 17.6''$

$s_{max} = 10''$ controls

$V_s = \frac{.22(60)(21)}{\text{[illegible]}}$ [illegible]

[illegible] 8.85 [illegible] = 37.4

OK [illegible]

NCR Form 381b
1 Aug 80

Plate D-78

```
100  DES MOINES AMPHITHEATER - BEAM "A"
110  KSI FT IN IN KIP
120 5 4 2 3000 .15
130 1 0 0    2 6.5 0    3 12.5 2.333    4 29 1.1667     5 47.25 0
140 FIX Y 1 2 4 5
145 FIX X 4 5
150 1 1 2    2 2 3   3 3 4   4 4 5
160 0 15 24 1 2 3 4
170 LOAD CASE 1 2 0 0 0 0 LIVE
180 Y -1.0 1
190 Y -1.5 2 3 4
220 LOAD CASE 2 2 0 1 0 0 DEAD
230 Y -1.031 1
240 Y -1.281 2 3 4
250 1 3 5 -21.5 2
300 COMBINATION 3 1 1.7 2 1.4 COMBINED FACTORED
```

1*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*

PROGRAM CFRAME V02.05 24JUL84

--*-*-*-*-*-*-*-*-*-*-*-*-*-*-*

RUN DATE = 30-JUL-1992

RUN TIME = 11.27.04

DES MOINES AMPHITHEATER — Beam "A"

*** JOINT DATA ***

			FIXITY					
JOINT	X	Y	X	Y	R	KX	KY	KR
	--- FT ---					---KIP / IN---		IN-KIP/RAD
1	.00	.00		*				
2	6.50	.00		*				
3	12.50	2.33						
4	29.00	1.17	*	*				
5	47.25	.00	*	*				

*** MEMBER DATA ***

MEMBER	END A	END B	LENGTH FT	I IN**4	A IN**2	AS IN**2	E KSI	G KSI
1	1	2	6.50	.1728E+05	.3600E+03	.3600E+03	.3000E+04	.1304E+04
2	2	3	6.44	.1728E+05	.3600E+03	.3600E+03	.3000E+04	.1304E+04
3	3	4	16.54	.1728E+05	.3600E+03	.3600E+03	.3000E+04	.1304E+04
4	4	5	18.29	.1728E+05	.3600E+03	.3600E+03	.3000E+04	.1304E+04

*** LOAD CASE 1 LIVE

MEMBER	DIRECTION	PROJECTED LOAD KIP / FT
1	Y	-.1000E+01
2	Y	-.1500E+01
3	Y	-.1500E+01
4	Y	-.1500E+01

Plate D-80

*** LOAD CASE 2 DEAD

MEMBER	DIRECTION	PROJECTED LOAD KIP / FT
1	Y	-.1031E+01
2	Y	-.1281E+01
3	Y	-.1281E+01
4	Y	-.1281E+01

MEMBER	L FT	P KIP	ANGLE DEG
2	3.00	.5000E+01	-21.50

*** LOAD CASE COMBINATIONS ***

LOAD CASE	LOAD CASE FACTORS 1	2
3	1.70	1.40

1 LOAD CASE 1 LIVE

JOINT DISPLACEMENTS

JOINT	DX IN	DY IN	DR RAD
1	-.1548E-01	.0000E+00	.9690E-04
2	-.1548E-01	.0000E+00	-.2727E-03
3	-.2372E-02	-.3454E-01	-.4316E-03
4	.0000E+00	.0000E+00	.8296E-04
5	.0000E+00	.0000E+00	.4989E-03

Plate I-7

MEMBER END FORCES

MEMBER	JOINT	AXIAL KIP	SHEAR KIP	MOMENT IN-KIP	MOMENT EXTREMA IN-KIP	LOCATION IN
1	1	.0000E+00	-.4133E+01	.0000E+00	.0000E+00	.00
	2	.0000E+00	.1063E+02	-.5758E+03	-.5758E+03	78.00
2	2	-.5811E+01	.1494E+02	-.5758E+03	.2547E+03	77.25
	3	-.2549E+01	-.6557E+01	.2547E+03	-.5758E+03	.00
3	3	.4960E+00	.7017E+01	.2547E+03	.4526E+03	55.58
	4	-.1249E+01	.1767E+02	-.8027E+03	-.8027E+03	198.49
4	4	.8732E+00	.1732E+02	-.8027E+03	.4017E+03	140.45
	5	-.8732E+00	.1000E+02	.0000E+00	-.8027E+03	.00

STRUCTURE REACTIONS

JOINT	FORCE X KIP	FORCE Y KIP	MOMENT IN-KIP
1	.0000E+00	-.4133E+01	.0000E+00
2	.0000E+00	.2667E+02	.0000E+00
4	.2334E+00	.3505E+02	.0000E+00
5	-.2333E+00	.1004E+02	.0000E+00

TOTAL	.2859E-04	.5762E+02	

1 LOAD CASE 2 DEAD

JOINT DISPLACEMENTS

JOINT	DX IN	DY IN	DR RAD
1	-.1507E-01	.0000E+00	.9984E-04
2	-.1507E-01	.0000E+00	-.2810E-03
3	-.2319E-02	-.3365E-01	-.3930E-03
4	.0000E+00	.0000E+00	.9635E-04
5	.0000E+00	.0000E+00	.4136E-03

MEMBER END FORCES

MEMBER	JOINT	AXIAL KIP	SHEAR KIP	MOMENT IN-KIP	MOMENT EXTREMA IN-KIP	LOCATION IN
1	1	.0000E+00	-.4257E+01	.0000E+00	.0000E+00	.00
	2	.0000E+00	.1096E+02	-.5934E+03	-.5934E+03	78.00
2	2	-.6662E+01	.1713E+02	-.5934E+03	.2615E+03	77.25
	3	-.2044E+01	-.5317E+01	.2615E+03	-.5934E+03	.00
3	3	.4236E+00	.5681E+01	.2615E+03	.4132E+03	51.61
	4	-.1067E+01	.1540E+02	-.7034E+03	-.7034E+03	198.49
4	4	.7457E+00	.1487E+02	-.7034E+03	.3366E+03	140.45
	5	-.7457E+00	.8460E+01	.0000E+00	-.7034E+03	.00

STRUCTURE REACTIONS

JOINT	FORCE X KIP	FORCE Y KIP	MOMENT IN-KIP
1	.0000E+00	-.4257E+01	.0000E+00
2	.0000E+00	.2934E+02	.0000E+00
4	.2265E+00	.3033E+02	.0000E+00
5	-.2045E+00	.8490E+01	.0000E+00
TOTAL	.2202E-01	.6390E+02	

1 LOAD CASE 3 COMBINED FACTORED

JOINT DISPLACEMENTS

JOINT	DX IN	DY IN	DR RAD
1	-.4742E-01	.0000E+00	.3045E-03
2	-.4742E-01	.0000E+00	-.8571E-03
3	-.7279E-02	-.1058E+00	-.1284E-02
4	.0000E+00	.0000E+00	.2759E-03
5	.0000E+00	.0000E+00	.1427E-02

MEMBER END FORCES

MEMBER	JOINT	AXIAL KIP	SHEAR KIP	MOMENT IN-KIP	MOMENT EXTREMA IN-KIP	LOCATION IN
1	1	.0000E+00	-.1299E+02	.0000E+00	.0000E+00	.00
	2	.0000E+00	.3342E+02	-.1810E+04	-.1810E+04	78.00
2	2	-.1921E+02	.4939E+02	-.1810E+04	.7991E+03	77.25
	3	-.7196E+01	-.1859E+02	.7991E+03	-.1810E+04	.00
3	3	.1436E+01	.1988E+02	.7991E+03	.1348E+04	55.58
	4	-.3617E+01	.5161E+02	-.2349E+04	-.2349E+04	198.49
4	4	.2529E+01	.5026E+02	-.2349E+04	.1154E+04	140.45
	5	-.2529E+01	.2885E+02	.0000E+00	-.2349E+04	.00

STRUCTURE REACTIONS

JOINT	FORCE X KIP	FORCE Y KIP	MOMENT IN-KIP
1	.0000E+00	-.1299E+02	.0000E+00
2	.0000E+00	.8641E+02	.0000E+00
4	.7138E+00	.1020E+03	.0000E+00
5	-.6830E+00	.2895E+02	.0000E+00
---	----------	----------	
TOTAL	.3086E-01	.2044E+03	

1 MEMBER END FORCES

MEMBER	LOAD CASE	JOINT	AXIAL KIP	SHEAR KIP	MOMENT IN-KIP	MOMENT EXTREMA IN-KIP	LOCATION IN
1	1	1	.0000E+00	-.4133E+01	.0000E+00	.0000E+00	.00
		2	.0000E+00	.1063E+02	-.5758E+03	-.5758E+03	78.00
	2	1	.0000E+00	-.4257E+01	.0000E+00	.0000E+00	.00
		2	.0000E+00	.1096E+02	-.5934E+03	-.5934E+03	78.00
	3	1	.0000E+00	-.1299E+02	.0000E+00	.0000E+00	.00
		2	.0000E+00	.3342E+02	-.1810E+04	-.1810E+04	78.00
2	1	2	-.5811E+01	.1494E+02	-.5758E+03	.2547E+03	77.25
		3	-.2549E+01	-.6557E+01	.2547E+03	-.5758E+03	.00
	2	2	-.6662E+01	.1713E+02	-.5934E+03	.2615E+03	77.25
		3	-.2044E+01	-.5317E+01	.2615E+03	-.5934E+03	.00
	3	2	-.1921E+02	.4939E+02	-.1810E+04	.7991E+03	77.25
		3	-.7196E+01	-.1859E+02	.7991E+03	-.1810E+04	.00

Plate D-24

3	1	3	.4960E+00	.7017E+01	.2547E+03	.4526E+03	55.58
		4	-.1249E+01	.1767E+02	-.8027E+03	-.8027E+03	198.49
	2	3	.4236E+00	.5681E+01	.2615E+03	.4132E+03	51.61
		4	-.1067E+01	.1540E+02	-.7034E+03	-.7034E+03	198.49
	3	3	.1436E+01	.1988E+02	.7991E+03	.1348E+04	55.58
		4	-.3617E+01	.5161E+02	-.2349E+04	-.2349E+04	198.49
4	1	4	.8732E+00	.1732E+02	-.8027E+03	.4017E+03	140.45
		5	-.8732E+00	.1000E+02	.0000E+00	-.8027E+03	.00
	2	4	.7457E+00	.1487E+02	-.7034E+03	.3366E+03	140.45
		5	-.7457E+00	.8460E+01	.0000E+00	-.7034E+03	.00
	3	4	.2529E+01	.5026E+02	-.2349E+04	.1154E+04	140.45
		5	-.2529E+01	.2885E+02	.0000E+00	-.2349E+04	.00

Subject: Des Moines Amphitheater | Date:
Computed by: TJW | Checked by: MW | Sheet 9 of 12

BEAM B

$Mu^-(max) = -2112 < -2349$ (Mu^- Beam A)
$Mu^+(max) = +1455 > 1348$ (Mu^+ Beam A)

$$\frac{Mu}{f'_c b d^2} = \frac{1455}{0.9(4)(15)(21)^2} = .0611$$

$w = .0635$

$\rho = .0635 (4/60) = .00423$

$As_{reqd} = 0.00423 (15)(21) = 1.33 \text{ in}^2$

3 #6 ($A_s = 1.32 \text{ in}^2$) OK

BEAM C

BEAM C will be OK since
LL = 100 psf for entire span
+ DL = 75 psf for entire span

which is less than Beam A
use same section

NCR Form 381b
1 Aug 80

```
100  DES MOINES AMPHITHEATER - Beam "E"
110  KSI FT IN IN KIP
120 6 5 2 3000 .15
130 1 0 0  2 6 0  3 9 0  4 15 2.33   5 28.5 1.167   6 44 0
140 FIX Y 1 2 5 6
145 FIX X 5 6
150 1 1 2   2 2 3  3 3 4  4 4 5   5 5 6
160 0 15 24 1 2 3 4 5
170 LOAD CASE 1 2 0 0 0 0 LIVE
180 Y -1.0 1 2
190 Y -1.5 3 4 5
220 LOAD CASE 2 2 0 1 0 0 DEAD
230 Y -1.031  1 2
240 Y -1.281 3 4 5
260 1 3 5 -21.5 3
300 COMBINATION 3 1 1.7 2 1.4 COMBINED FACTORED
```

1*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*
PROGRAM CFRAME V02.05 24JUL84
--*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*

RUN DATE = 03-AUG-1992
RUN TIME = 9.59.12

DES MOINES AMPHITHEATER - BEAM "B"

1 LOAD CASE 1 LIVE

JOINT DISPLACEMENTS

JOINT	DX IN	DY IN	DR RAD
1	-.1670E-01	.0000E+00	.9873E-04
2	-.1670E-01	.0000E+00	-.2768E-03
3	-.1670E-01	-.1651E-01	-.5258E-03
4	-.4161E-02	-.4935E-01	-.2176E-03
5	.0000E+00	.0000E+00	.2051E-03
6	.0000E+00	.0000E+00	.2337E-03

MEMBER END FORCES

MEMBER	JOINT	AXIAL KIP	SHEAR KIP	MOMENT IN-KIP	MOMENT EXTREMA IN-KIP	LOCATION IN
1	1	.0000E+00	-.5512E+01	.0000E+00	.0000E+00	.00
	2	.0000E+00	.1151E+02	-.6128E+03	-.6128E+03	72.00
2	2	.0000E+00	.1513E+02	-.6128E+03	-.1220E+03	36.00
	3	.0000E+00	-.1213E+02	-.1220E+03	-.6128E+03	.00
3	3	-.4393E+01	.1131E+02	-.1220E+03	.4276E+03	77.24
	4	-.1135E+01	-.2922E+01	.4276E+03	-.1220E+03	.00
4	4	.2690E+00	.3123E+01	.4276E+03	.4669E+03	26.02
	5	-.1469E+01	.1705E+02	-.7049E+03	-.7049E+03	162.60
5	5	.8728E+00	.1537E+02	-.7049E+03	.2456E+03	123.11
	6	-.8728E+00	.7813E+01	.0000E+00	-.7049E+03	.00

STRUCTURE REACTIONS

JOINT	FORCE X KIP	FORCE Y KIP	MOMENT IN-KIP
1	.0000E+00	-.5512E+01	.0000E+00
2	.0000E+00	.2665E+02	.0000E+00
5	.2837E+00	.3251E+02	.0000E+00
6	-.2837E+00	.7857E+01	.0000E+00
TOTAL	.1506E-04	.6150E+02	

1 LOAD CASE 2 DEAD

JOINT DISPLACEMENTS

JOINT	DX IN	DY IN	DR RAD
1	-.1759E-01	.0000E+00	.1135E-03
2	-.1759E-01	.0000E+00	-.3140E-03
3	-.1759E-01	-.1864E-01	-.5865E-03
4	-.4479E-02	-.5298E-01	-.1932E-03
5	.0000E+00	.0000E+00	.2365E-03
6	.0000E+00	.0000E+00	.1697E-03

MEMBER END FORCES

MEMBER	JOINT	AXIAL KIP	SHEAR KIP	MOMENT IN-KIP	MOMENT EXTREMA IN-KIP	LOCATION IN
1	1	.0000E+00	-.6489E+01	.0000E+00	.0000E+00	.00
	2	.0000E+00	.1268E+02	-.6899E+03	-.6899E+03	72.00
2	2	.0000E+00	.1756E+02	-.6899E+03	-.1134E+03	36.00
	3	.0000E+00	-.1447E+02	-.1134E+03	-.6899E+03	.00
3	3	-.5237E+01	.1349E+02	-.1134E+03	.4598E+03	77.24
	4	-.6226E+00	-.1670E+01	.4598E+03	-.1134E+03	.00
4	4	.1770E+00	.1774E+01	.4598E+03	.4746E+03	16.26
	5	-.1307E+01	.1546E+02	-.6526E+03	-.6526E+03	162.60
5	5	.7453E+00	.1340E+02	-.6526E+03	.1930E+03	126.84
	6	-.7453E+00	.6401E+01	.0000E+00	-.6526E+03	.00

STRUCTURE REACTIONS

JOINT	FORCE X KIP	FORCE Y KIP	MOMENT IN-KIP
1	.0000E+00	-.6489E+01	.0000E+00
2	.0000E+00	.3024E+02	.0000E+00
5	.2869E+00	.2893E+02	.0000E+00
6	-.2627E+00	.6439E+01	.0000E+00
TOTAL	.2418E-01	.5911E+02	

1 LOAD CASE 3 COMBINED FACTORED

JOINT DISPLACEMENTS

JOINT	DX IN	DY IN	DR RAD
1	-.5302E-01	.0000E+00	.3268E-03
2	-.5302E-01	.0000E+00	-.9103E-03
3	-.5302E-01	-.5417E-01	-.1715E-02
4	-.1334E-01	-.1581E+00	-.6404E-03
5	.0000E+00	.0000E+00	.6798E-03
6	.0000E+00	.0000E+00	.6349E-03

MEMBER END FORCES

MEMBER	JOINT	AXIAL KIP	SHEAR KIP	MOMENT IN-KIP	MOMENT EXTREMA IN-KIP	LOCATION IN
1	1	.0000E+00	-.1846E+02	.0000E+00	.0000E+00	.00
	2	.0000E+00	.3732E+02	-.2008E+04	-.2008E+04	72.00
2	2	.0000E+00	.5031E+02	-.2008E+04	-.3662E+03	36.00
	3	.0000E+00	-.4088E+02	-.3662E+03	-.2008E+04	.00
3	3	-.1480E+02	.3811E+02	-.3662E+03	.1371E+04	77.24
	4	-.2800E+01	-.7305E+01	.1371E+04	-.3662E+03	.00
4	4	.7051E+00	.7791E+01	.1371E+04	.1455E+04	22.76
	5	-.4328E+01	.5063E+02	-.2112E+04	-.2112E+04	162.60
5	5	.2527E+01	.4489E+02	-.2112E+04	.6869E+03	123.11
	6	-.2527E+01	.2224E+02	.0000E+00	-.2112E+04	.00

STRUCTURE REACTIONS

JOINT	FORCE X KIP	FORCE Y KIP	MOMENT IN-KIP
1	.0000E+00	-.1846E+02	.0000E+00
2	.0000E+00	.8763E+02	.0000E+00
5	.8839E+00	.9576E+02	.0000E+00
6	-.8501E+00	.2237E+02	.0000E+00
TOTAL	.3386E-01	.1873E+03	

1 MEMBER END FORCES

MEMBER	LOAD CASE	JOINT	AXIAL KIP	SHEAR KIP	MOMENT IN-KIP	MOMENT EXTREMA IN-KIP	LOCATION IN
1	1	1	.0000E+00	-.5512E+01	.0000E+00	.0000E+00	.00
		2	.0000E+00	.1151E+02	-.6128E+03	-.6128E+03	72.00
	2	1	.0000E+00	-.6489E+01	.0000E+00	.0000E+00	.00
		2	.0000E+00	.1268E+02	-.6899E+03	-.6899E+03	72.00
	3	1	.0000E+00	-.1846E+02	.0000E+00	.0000E+00	.00
		2	.0000E+00	.3732E+02	-.2008E+04	-.2008E+04	72.00
2	1	2	.0000E+00	.1513E+02	-.6128E+03	-.1220E+03	36.00
		3	.0000E+00	-.1213E+02	-.1220E+03	-.6128E+03	.00
	2	2	.0000E+00	.1756E+02	-.6899E+03	-.1134E+03	36.00
		3	.0000E+00	-.1447E+02	-.1134E+03	-.6899E+03	.00
	3	2	.0000E+00	.5031E+02	-.2008E+04	-.3662E+03	36.00
		3	.0000E+00	-.4088E+02	-.3662E+03	-.2008E+04	.00
3	1	3	-.4393E+01	.1131E+02	-.1220E+03	.4276E+03	77.24
		4	-.1135E+01	-.2922E+01	.4276E+03	-.1220E+03	.00
	2	3	-.5237E+01	.1349E+02	-.1134E+03	.4598E+03	77.24
		4	-.6226E+00	-.1670E+01	.4598E+03	-.1134E+03	.00
	3	3	-.1480E+02	.3811E+02	-.3662E+03	.1371E+04	77.24
		4	-.2800E+01	-.7305E+01	.1371E+04	-.3662E+03	.00
4	1	4	.2690E+00	.3123E+01	.4276E+03	.4669E+03	26.02
		5	-.1469E+01	.1705E+02	-.7049E+03	-.7049E+03	162.60
	2	4	.1770E+00	.1774E+01	.4598E+03	.4746E+03	16.26
		5	-.1307E+01	.1546E+02	-.6526E+03	-.6526E+03	162.60
	3	4	.7051E+00	.7791E+01	.1371E+04	.1455E+04	22.76
		5	-.4328E+01	.5063E+02	-.2112E+04	-.2112E+04	162.60
5	1	5	.8728E+00	.1537E+02	-.7049E+03	.2456E+03	123.11
		6	-.8728E+00	.7813E+01	.0000E+00	-.7049E+03	.00
	2	5	.7453E+00	.1340E+02	-.6526E+03	.1930E+03	126.84
		6	-.7453E+00	.6401E+01	.0000E+00	-.6526E+03	.00
	3	5	.2527E+01	.4489E+02	-.2112E+04	.6869E+03	123.11
		6	-.2527E+01	.2224E+02	.0000E+00	-.2112E+04	.00

Subject Des Moines Amphitheater		Date Nov 91	
Computed by TJW	Checked by MW	Sheet 10	of 12

STAIRS

Design on per width basis

$h = 8''$ $d = 6''$ $b = 12''$

$LL = 100\ \#/ft$

$DL = \frac{8''}{12}(150) + \frac{\frac{1}{2}(6)(150)}{12} = 138\ \#/ft$

$SPAN = 18'$

$M_u = \left[100(1.7) + 138(1.4)\right] 18^2/8$

$= 14{,}710\ \#\text{-}ft$

$\frac{M_u}{f'_c b d^2} = \frac{14710}{.9(4000)(1)6^2} = 0.1135$

$\omega = 0.122$

$\rho = 0.122\left(\frac{4}{60}\right) = 0.00813$

$A_{s\,req} = 0.00813(6)(12) = 0.59\ in^2$

use #5 @ 6

$A_s = 0.62$

Subject Des Moines Amphitheater		Date Nov 91
Computed by TJW	Checked by MW	Sheet 11 of 1

Foundation Design

Center pile (joint 4, Beam A)

$$\text{Load on pile} = \overset{\text{Live}}{32.4^k} + \overset{\text{Dead}}{28.1^k} = 60.5^k$$

Use the same piles as for Arch Foundation

$Q_{allow} = 187^k$

ok $> Q_{DESIGN} = 60.5$

Subject Des Moines Amphitheater		Date Nov 91
Computed by TJW	Checked by MW	Sheet 12 of 17

Pile Design

BEAM C Joint 1

From Stage
Reaction = $\frac{3W}{8}l$ = $\frac{3}{8}(2031)(20)$ = $15,232^{\#}$

From Riverwalk
Reaction = $\frac{1}{2}wl = \frac{1}{2}(2850)16$ = $22800^{\#}$

Load Wall = $(1')(10')(15')(150)$ = $22,500^{\#}$

Total Load = 60.5^{K} < 187^{K} OK

Subject: Des Moines Amphitheater		Date: July 92
Computed by: TJW	Checked by: MW	Sheet 1 of 10

Riverwalk

The riverwalk will be design to resist Ice load = 5 kip/ft width and LL = 150 psf each combined with Dead load as shown on sheet 7

Subject Des Moines Amphitheater		Date July 92
Computed by TJW	Checked by MW	Sheet 2 of 10

Determine Area and C.G. of walkway

Area = $A_1 - A_2$

$\theta_1 = \cos^{-1}(20/46) = 64^\circ$

$X_1 = \sqrt{46^2 - 20^2} = 41.4'$

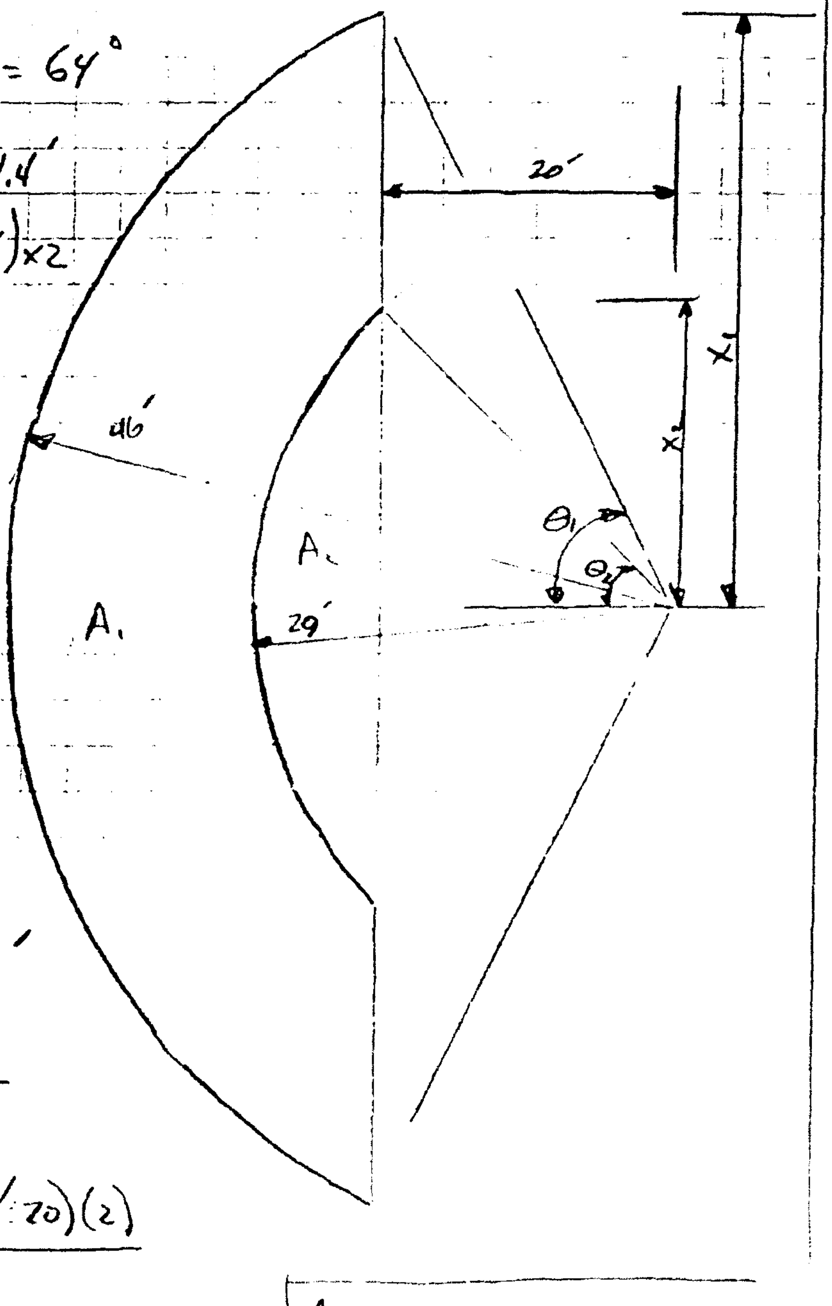
$S_1 = 64^\circ\left(\frac{\pi\ rd}{180^\circ}\right)(46')\times 2$

$= 102.8'$

$A_1 = \frac{S_1 R - X_1(20)}{2}$

$= \frac{(102.8)(46) - 41.4\times 2\times 20}{2}$

$= 1536$



$\theta_2 = \cos^{-1}\left(\frac{20}{29}\right)$

$= 46^\circ$

$X_2 = \sqrt{29^2 - 20^2} = 21'$

$S_2 = 46^\circ\left(\frac{\pi}{180}\right)(29')\times 2$

$= 46.6'$

$A_2 = \frac{46.6'(29) - 21(20)(2)}{2}$

$= 256$

Area = 1536 - 256
= 1280 sf

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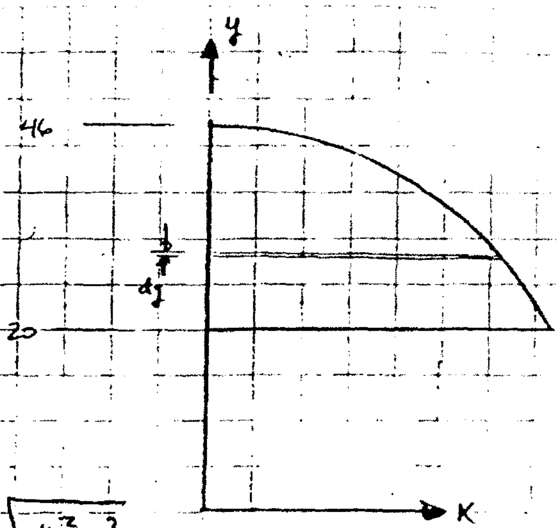
Subject: Des Moines Amphitheater		Date: July 92
Computed by: TJW	Checked by: MW	Sheet 3 of 10

Find Centroid of Cap



$$\bar{y} = \frac{M_x}{A}$$

$$M_{x_1} = \int_{20}^{46} y \cdot X \, dy$$

$$x^2 + y^2 = 46^2 \Rightarrow x = \sqrt{46^2 - y^2}$$

$$M_{x_1} = \int_{20}^{46} y \sqrt{46^2 - y^2} \cdot dy = -\frac{1}{3}\sqrt{(46^2 - y^2)^3}\Bigg|_{20}^{46}$$

$$M_{x_1} = 0 - \left(-\frac{1}{3}\sqrt{(46^2 - 20^2)^3}\right) = 23{,}695$$

$$M_{x_2} = 0 + \frac{1}{3}\sqrt{(29^2 - 20^2)^3} = 3{,}087$$

$$\bar{y} = \frac{2(23695 - 3087)}{1280} = 32.2'$$

Subject: Des Moine Amphitheater		Date: July 92
Computed by: TJW	Checked by: MW	Sheet 4 of 10

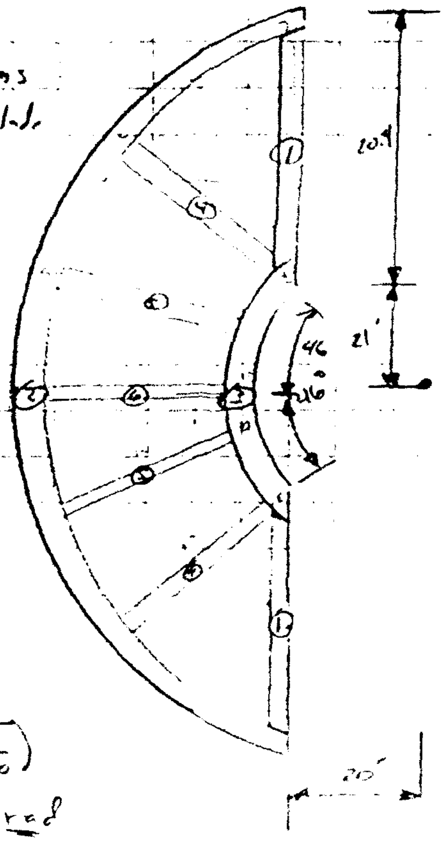
Compute Dead LOAD

1' slab

$Wt = 1280\ sf(1)(.15) = 192.0\ K$

$M_y = 192\ (32.2) = 6182\ k\text{-}ft$

External Beams – Try 3' wide beams
(1, 2, 3) $1\frac{1}{2}$' deep (does not include slab)



determine wt and moment about origin.

$Wt_1 = 2\left[(20.4 - 2(3))\right](1.5)(3)(.15)$
$= 19.44\ K$

$M_1 = 19.44\ (21.5) = 418\ k\text{-}ft$

$Wt_2 = 2(64°)\frac{\pi}{180}(44.5)(3)(1.5)(.15)$
$= 67.1\ K$

$\bar{y}_2 = \frac{r \sin \theta}{\theta}$ $\theta = 64\left(\frac{\pi}{180}\right)$
$= 1.117\ rad$

$\bar{y}_2 = \frac{44.[illegible] \sin(1.117)}{1.117} = 35.81'$

$M_2 =$ [illegible] $= 240$[illegible]

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Subject: Des Moines Amphitheater		Date: July 92
Computed by: TJW	Checked by: MW	Sheet: 5 of 10

$$Wt_3 = 2 * 46^\circ\left(\frac{\pi}{180}\right)(30.5')(3')(1.5')(.15) = 33.1^K$$

$$\theta = 46^\circ \frac{\pi}{180} = .803$$

$$\bar{y}_3 = \frac{30.5 \sin(.803)}{.803} = 27.33'$$

$$M_3 = 27.33'(33.1^K) = 905 \text{ k-ft}$$

<u>Internal Beam</u> 4, 5, 6 — Try 3' wide & 18" deep (not including slab)

$$Wt/beam = 10'(3')(1.5')(.15) = 6.75\ k\ /beam$$

$$Wt_{I.B} = 5(6.75) = 33.8^K$$

$$\bar{y}_4 = \left(46 - 3 - \frac{10}{2}\right)\cos 46^\circ = 26.40$$

$$M_4 = 2 \times 6.75 \times 26.40 = 356 \text{ k-ft}$$

$$\bar{y}_5 = (43 - 5) \times \cos\left(\frac{46}{2}\right) = 34.98$$

$$M_5 = 2(6.75) \times 34.98 = 472$$

$$\bar{y}_6 = 43 - 5 = 38'$$

$$M_6 = 6.75(38) = 257$$

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Subject: Des Moines Amphitheater		Date: July 92
Computed by: TJW	Checked by: MW	Sheet 6 of 10

$$\text{Total Wt}(P_z) = 192 + 19.4 + 67.1 + 33.1 + 133.8$$
$$= 345.4$$

$$\text{Total Moment abt origin} = 6182 + 418 + 2403 + 905$$
$$+ 356 + 472 + 257$$

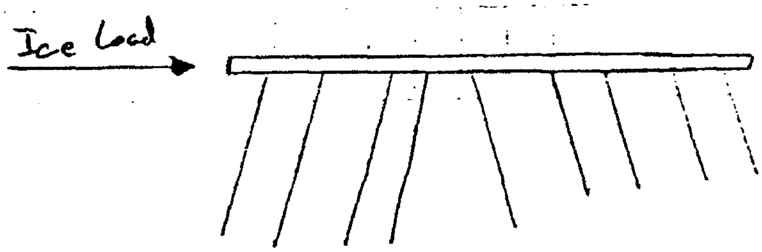
$$M_x = 10993 \text{ k}\cdot\text{ft}$$

ICE LOAD

$$P_x = 26'(5.0 \text{ k/ft}) = 130^k$$

$$M_z = -130^k\left(46 - \frac{26}{2}\right) = -4290 \text{ k}\cdot\text{ft}$$

(Force P_x produces a Negative moment (M_z) about the origin)



NCR Form 381b
1 Aug 80

Plate D-100

Subject: Des Moines Amphitheater	Date: July 92
Computed by: TJW · Checked by: MW	Sheet 7 of 10

Live Load

$LL = 150\ psf$

For CPGA

$P_z = .150^{ksf}(1280) = 192^{k}$

$M_x = 192^{k}(32.2) = 6182\ k\text{-}ft$

SUMMARY OF LOADS

Load Case I - DL + ICE

Load Case II - DL + LL

CASE	Px	PY	PZ	Mx	My	Mz
1	130	0	345.4	10993	0	-4290
2	0	0	345.4 + 192.0 = 537.4	10993 + 6182 = 17175	0	0

Subject Des Moines Amphitheater		Date July 92
Computed by TJW	Checked by [illegible]	Sheet 8 of 15

Pile Layout

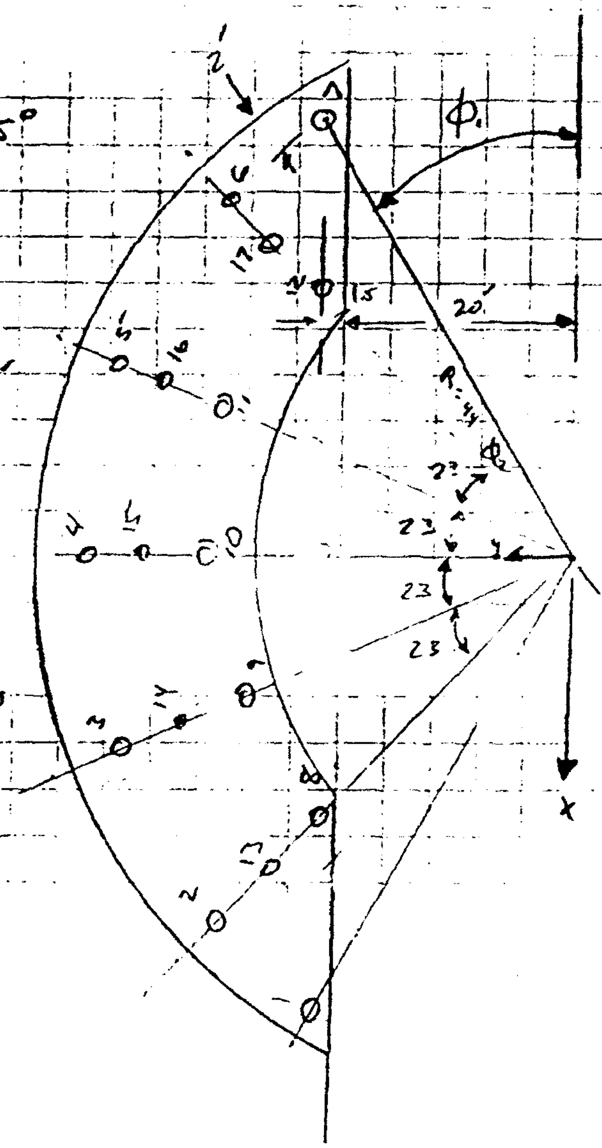
$$\phi = \sin^{-1}\left(\frac{21.5}{44}\right) = 29.25^\circ$$

$$\phi_2 = 90^\circ - 29.25^\circ - 2(23^\circ) = 14.75^\circ$$

Inside row radius = 30.5'

Outside Radius 44'

middle row 37.5'



Batter

4:1

3, 4, 5, 8, 9, 10
13, 14, 16.

6:1 1, 2, 6, 7, 12, 17

Batter Angle

0 - 1, 2, 3, 4, 5, 8, 9, 10, 11, 13, 14, 15, 16

180 6, 7, 12, 17

NCR Form 381b
1 Aug 80

Plate D-102

Subject: Des Moines Amphitheater		Date: July 9?
Computed by: TJW	Checked by: [illegible]	Sheet 9 of 10

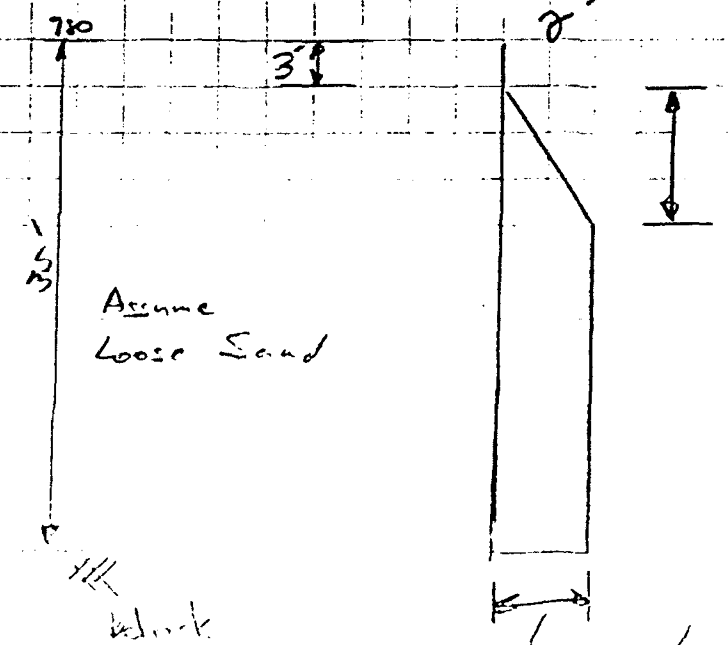
Pile Analysis

Piles will bear on rock ~ 35' below the top of the river walk

use same piles as for Arch foundation

$A = 19.2 \ in^2$
$I = 362 \ in^4$
$S = 56.7 \ in^3$
$r = 4.33 \ in$

Use Same Allowable Forces & Moment as for Arch foundation except for Tension Piles



$D_c = 10B = 10'$

10' (loose sand)

$10(120 - 62.5) = 575 \ psf$

NCR Form 381b
1 Aug 80

Subject: Des Moines Amphitheater		Date: July 92
Computed by: TJW	Checked by: [illegible]	Sheet 10 of 10

use $K_t = 0.50$

$\delta = 0.67\phi \qquad \phi = 28$

$\delta = 18.8^\circ$

$f_s = K_t \, \sigma_v' \tan\delta = 97.87 \text{ psf}$

$$Q_{ult} = \left(\tfrac{1}{2}(10) + 22\right)\left(\frac{\pi \cdot 12.75}{12}\right) 97.87 = 8820^{\#}$$

$$Q_{allow} = \frac{Q_{ult}}{2.25} + W_{pile} + (\text{Soil \& Concrete in pile})^{*}$$

$$= \frac{8.8^k}{2.25} + 35\,(65.42)/1000 + 35'\left[\frac{\pi}{4}\left(\frac{11.75}{12}\right)^2\right](.120 \text{ kcf})$$

$$= 3.9 + 2.3 + 3.2$$

$$= 9.4^k$$

* Fill pile with Concrete after driving
use .120 kcf since much of the pile
will be fill with soil already

NCR Form 381b
1 Aug 80

Plate D-104

```
1000 DES MOINES AMPLITHEATER -
1010 ICE LOAD ON RRIVERWALK USING 12" PIPE PILES
1030 PRO 29000 362 362 19.2 1 5 ALL
1040 SOI NH .005 TIP 35 3 ALL
1050 FIX ALL
1060 ALLOW R 187 9.4 336 336 1100 1100 ALL
1070 ARC 0 0 0 44 29.25 1 7 14.75 23 23 23 23 14.75
1080 ARC 0 0 0 30.5 44 8 5 23 23 23 23
1090 ARC 0 0 0 37.5 44 13 5 23 23 23 23
2000 BAT 4 3 4 5 8 TO 10 13 TO 16
2020 BAT 6 1 2 6 7 11 12 17
2050 ANGLE 180 6 7 12 17
2100 LOAD 1 130.0 0 345 10993 0 -4290
2150 LOAD 2 0 0 537.5 17175 0 0
2200 FOUT 1 2 3 4 5 6 7 DAY.OUT
2300 PFO ALL
```

```
**********************************
* CORPS PROGRAM  #  X0080        *  CPGA - CASE PILE GROUP ANALYSIS PROGRAM
* VERSION NUMBER # 1992/02/26    *  RUN DATE 06-AUG-1992   RUN TIME 14.24.44
**********************************

DES MOINES AMPLITHEATER
ICE LOAD ON RRIVERWALK USING 12" PIPE PILES

THERE ARE  17 PILES AND
            2 LOAD CASES IN THIS RUN.

ALL PILE COORDINATES ARE CONTAINED WITHIN A BOX
                                    X          Y          Z
                                  -----      -----      -----
WITH DIAGONAL COORDINATES = (    -38.39 ,    21.19 ,      .00 )
                            (     38.39 ,    44.00 ,      .00 )

*****************************************************************************

         PILE PROPERTIES AS INPUT

       E            I1           I2           A            C33          B66
      KSI          IN**4        IN**4        IN**2
   .29000E+05   .36200E+03   .36200E+03   .19200E+02   .10000E+01   .50000E+01

THESE PILE PROPERTIES APPLY TO THE FOLLOWING PILES -

    ALL

*****************************************************************************
```

SOIL DESCRIPTIONS AS INPUT

NH	ESOIL K/IN**3	LENGTH	L FT	LU FT
	.50000E-02	T	.35000E+02	.30000E+01

THIS SOIL DESCRIPTION APPLIES TO THE FOLLOWING PILES -

ALL

****

PILE GEOMETRY AS INPUT AND/OR GENERATED

NUM	X FT	Y FT	Z FT	BATTER	ANGLE	LENGTH FT	FIXITY
1	38.39	21.50	.00	6.00	.00	35.48	F
2	31.65	30.56	.00	6.00	.00	35.48	F
3	17.19	40.50	.00	4.00	.00	36.08	F
4	.00	44.00	.00	4.00	.00	36.08	F
5	-17.19	40.50	.00	4.00	.00	36.08	F
6	-31.65	30.56	.00	6.00	180.00	35.48	F
7	-38.39	21.50	.00	6.00	180.00	35.48	F
8	21.94	21.19	.00	4.00	.00	36.08	F
9	11.92	28.08	.00	4.00	.00	36.08	F
10	.00	30.50	.00	4.00	.00	36.08	F
11	-11.92	28.08	.00	6.00	.00	35.48	F
12	-21.94	21.19	.00	6.00	180.00	35.48	F
13	26.98	26.05	.00	4.00	.00	36.08	F
14	14.65	34.52	.00	4.00	.00	36.08	F
15	.00	37.50	.00	4.00	.00	36.08	F
16	-14.65	34.52	.00	4.00	.00	36.08	F
17	-26.98	26.05	.00	6.00	180.00	35.48	F

						609.15	

****

APPLIED LOADS

LOAD CASE	PX K	PY K	PZ K	MX FT-K	MY FT-K	MZ FT-K
1	130.0	.0	345.0	10993.0	.0	-4290.0
2	.0	.0	537.5	17175.0	.0	.0

****

ORIGINAL PILE GROUP STIFFNESS MATRIX

.12992E+04	.12187E-04	.27743E+04	.11597E+07	-.63636E+06	-.48983E+06
.12187E-04	.30936E+03	-.73122E-04	-.25758E+05	-.26095E-01	.35069E+04
.27743E+04	-.73122E-04	.21025E+05	.76454E+07	.41226E+05	-.11597E+07
.11597E+07	-.25758E+05	.76454E+07	.29340E+10	.11791E+08	-.49937E+09
-.63636E+06	-.26095E-01	.41226E+05	.11791E+08	.15738E+10	.18819E+09
-.48983E+06	.35069E+04	-.11597E+07	-.49937E+09	.18819E+09	.21884E+09

LOAD CASE 1. NUMBER OF FAILURES = 0. NUMBER OF PILES IN TENSION = 3.

LOAD CASE 2. NUMBER OF FAILURES = 0. NUMBER OF PILES IN TENSION = 0.

****

PILE CAP DISPLACEMENTS

LOAD CASE	DX IN	DY IN	DZ IN	RX RAD	RY RAD	RZ RAD
1	.1257E+00	-.8791E-02	.3773E-01	-.1145E-03	.5851E-04	-.6534E-04
2	-.7613E-01	.1917E-01	-.4672E-01	.2615E-03	-.5890E-04	.2290E-03

****

PILE FORCES IN LOCAL GEOMETRY

M1 & M2 NOT AT PILE HEAD FOR PINNED PILES
* INDICATES PILE FAILURE
# INDICATES CBF BASED ON MOMENTS DUE TO (F3*EMIN) FOR CONCRETE PILES
B INDICATES BUCKLING CONTROLS

LOAD CASE - 1

PILE	F1 K	F2 K	F3 K	M1 IN-K	M2 IN-K	M3 IN-K	ALF	CBF
1	2.7	-.5	6.5	40.3	234.4	.0	.03	.24
2	2.9	-.5	-2.0	32.1	247.2	.0	.21	.23
3	3.0	-.3	11.7	15.9	259.7	.0	.06	.27
4	3.0	.0	21.6	-5.0	261.1	.0	.12	.30
5	2.9	.2	41.8	-25.9	250.6	.0	.22	.35
6	-2.8	-.5	-9.0	49.1	-245.0	.0	.96	.25
7	-2.8	-.6	14.7	57.3	-238.5	.0	.08	.27
8	2.6	-.3	35.9	21.7	228.2	.0	.19	.32
9	2.7	-.2	34.6	9.5	237.2	.0	.18	.32
10	2.8	.0	41.5	-5.0	238.2	.0	.22	.34
11	2.7	.2	41.5	-20.9	235.5	.0	.22	.34
12	-2.7	-.3	.4	37.3	-235.3	.0	.00	.22
13	2.7	-.4	24.4	27.8	237.7	.0	.13	.29
14	2.9	-.2	22.7	12.8	248.9	.0	.12	.29
15	2.9	.0	31.2	-5.0	250.1	.0	.17	.32
16	2.8	.2	48.4	-22.8	241.1	.0	.26	.36
17	-2.8	-.4	-4.5	43.4	-240.4	.0	.48	.24

LOAD CASE - 2

PILE	F1 K	F2 K	F3 K	M1 IN-K	M2 IN-K	M3 IN-K	ALF	CBF
1	-2.7	1.9	32.7	-150.2	-230.6	.0	.17	.35
2	-3.2	1.6	57.9	-121.5	-274.8	.0	.31	.45
3	-3.8	.9	57.0	-64.2	-328.4	.0	.30	.47
4	-4.0	.0	52.5	9.1	-342.4	.0	.28	.47
5	-3.7	-.8	26.6	82.4	-319.2	.0	.14	.38
6	2.9	1.7	69.0	-163.1	249.7	.0	.37	.48
7	2.5	2.0	20.8	-191.8	220.0	.0	.11	.33
8	-2.6	1.1	2.1	-84.4	-227.0	.0	.01	.23
9	-3.0	.6	14.3	-41.7	-260.9	.0	.08	.28
10	-3.1	.0	11.2	9.1	-270.7	.0	.06	.28
11	-2.9	-.6	9.5	64.2	-254.5	.0	.05	.27
12	2.5	1.2	34.4	-121.7	216.0	.0	.18	.33
13	-2.9	1.4	21.4	-105.9	-254.2	.0	.11	.31
14	-3.4	.8	36.4	-53.4	-295.9	.0	.19	.38
15	-3.6	.0	32.6	9.1	-307.9	.0	.17	.38
16	-3.3	-.7	10.6	71.6	-288.1	.0	.06	.30
17	2.7	1.5	52.3	-143.2	233.5	.0	.28	.40

****

PILE FORCES IN GLOBAL GEOMETRY

LOAD CASE - 1

PILE	PX K	PY K	PZ K	MX IN-K	MY IN-K	MZ IN-K
1	3.7	-.5	5.9	39.7	234.4	-6.6
2	2.5	-.5	-2.4	31.7	247.2	-5.3
3	5.8	-.3	10.6	15.4	259.7	-3.9
4	8.2	.0	20.3	-4.9	261.1	1.2
5	13.0	.2	39.9	-25.2	250.6	6.3
6	4.3	.5	-8.4	-48.4	245.0	-8.1
7	.3	.6	14.9	-56.5	238.5	-9.4
8	11.3	-.3	34.2	21.0	228.2	-5.3
9	11.0	-.2	32.9	9.2	237.2	-2.3
10	12.7	.0	39.6	-4.9	238.2	1.2
11	9.5	.2	40.5	-20.6	235.5	3.4
12	2.6	.3	.8	-36.8	235.3	-6.1
13	8.6	-.4	23.0	26.9	237.7	-6.7
14	8.3	-.2	21.4	12.4	248.9	-3.1
15	10.4	.0	29.6	-4.9	250.1	1.2
16	14.4	.2	46.3	-22.2	241.1	5.5
17	3.5	.4	-4.0	-42.8	240.4	-7.1

LOAD CASE - 2

PILE	PX K	PY K	PZ K	MX IN-K	MY IN-K	MZ IN-K
1	2.7	1.9	32.7	-148.2	-230.6	24.7
2	6.4	1.6	57.6	-119.8	-274.8	20.0
3	10.1	.9	56.2	-62.3	-328.4	15.6
4	8.9	.0	51.9	8.8	-342.4	-2.2
5	2.9	-.8	26.7	79.9	-319.2	-20.0
6	-14.2	-1.7	67.6	160.9	-249.7	26.8
7	-5.9	-2.0	20.1	189.2	-220.0	31.5
8	-2.0	1.1	2.7	-81.9	-227.0	20.5
9	.5	.6	14.6	-40.5	-260.9	10.1
10	-.3	.0	11.6	8.8	-270.7	-2.2

11	-1.3	-.6	9.9	63.4	-254.5	-10.6
12	-8.1	-1.2	33.5	120.1	-216.0	20.0
13	2.3	1.4	21.5	-102.7	-254.2	25.7
14	5.5	.8	36.2	-51.8	-295.9	12.9
15	4.5	.0	32.5	8.8	-307.9	-2.2
16	-.7	-.7	11.1	69.4	-288.1	-17.4
17	-11.3	-1.5	51.2	141.2	-233.5	23.5

HYDROLOGY AND HYDRAULICS

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E

DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM NO. 8
WITH ENVIRONMENTAL ASSESSMENT
DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER

DES MOINES, IOWA

APPENDIX E
HYDROLOGY AND HYDRAULICS

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APPENDIX E
HYDROLOGY AND HYDRAULICS

1. GENERAL DESCRIPTION

a. This appendix discusses the hydrologic and hydraulic considerations of the Riverfront Amphitheater which is part of the Des Moines Recreational River and Greenbelt development. The amphitheater is on the east side of the Des Moines River between Locust Street (river mile 202.226) and Walnut Street (river mile 202.224).

2. CLIMATE

Des Moines, Iowa, experiences a continental climate. The average yearly temperature is about 50 degrees Fahrenheit. Temperatures during the year fluctuate between -21 degrees Fahrenheit in midwinter to 105 degrees Fahrenheit in midsummer. The average yearly rainfall is about 31 inches; yearly minimum and maximum rainfalls range from 17.1 inches to 56.8 inches. The average seasonal snowfall is about 32 inches. Average monthly data for 34 years of record, collected by the National Weather Service, at the Des Moines municipal airport appear in table E-1.

TABLE E-1
AVERAGE MONTHLY WEATHER DATA SUMMARY FOR DES MOINES

Month	Precip. (Inches)	Temp. (Deg.F)	Snowfall (Inches)
January	1.13	20.7	8.5
February	1.13	24.7	6.7
March	1.92	36.3	7.2
April	2.82	50.4	1.5
May	4.26	61.4	trace
June	4.65	71.1	0
July	3.42	76.0	0
August	3.53	73.7	0
September	3.45	65.4	0
October	2.38	54.2	0.1
November	1.58	38.4	2.4
December	1.19	26.1	6.2
Yearly	31.46	49.9	32.6

3. IMPACTS OF CONSTRUCTION ON THE DESIGN FLOOD PROFILE

a. Construction near the river can increase adjacent and upstream water levels. This can increase the amount of flood damage to property owners or decrease the level of protection offered by existing flood control facilities. In the past it has been observed that while small encroachments within the floodway individually may be negligible, the combined impact may be significant. In other words, piecemeal approval for encroachments may produce undesirable consequences.

b. However, the analyses made for this appendix evaluated the impacts of the proposed amphitheater only. Detailed plans were used to determine the extent of the encroachment, including modifications to the bank slope. Plate E-1 shows the changes made at the most restrictive cross-section. Ideally, project encroachments would be inserted in the model used to compute the design profile. Since the original model is no longer available, the flood insurance study model with some modifications was used. The model was partially calibrated to reproduce the original design profile. The design flood has a discharge of 40,000 cubic feet per second. This discharge is slightly larger than the 1 percent chance event from the Flood Insurance Study.

c. The largest water surface profile increase was 0.01 feet and extended only a short distance. This increase is considered insignificant; the level of protection of the local flood protection project is maintained as originally designed.

4. AMPHITHEATER DRAINAGE

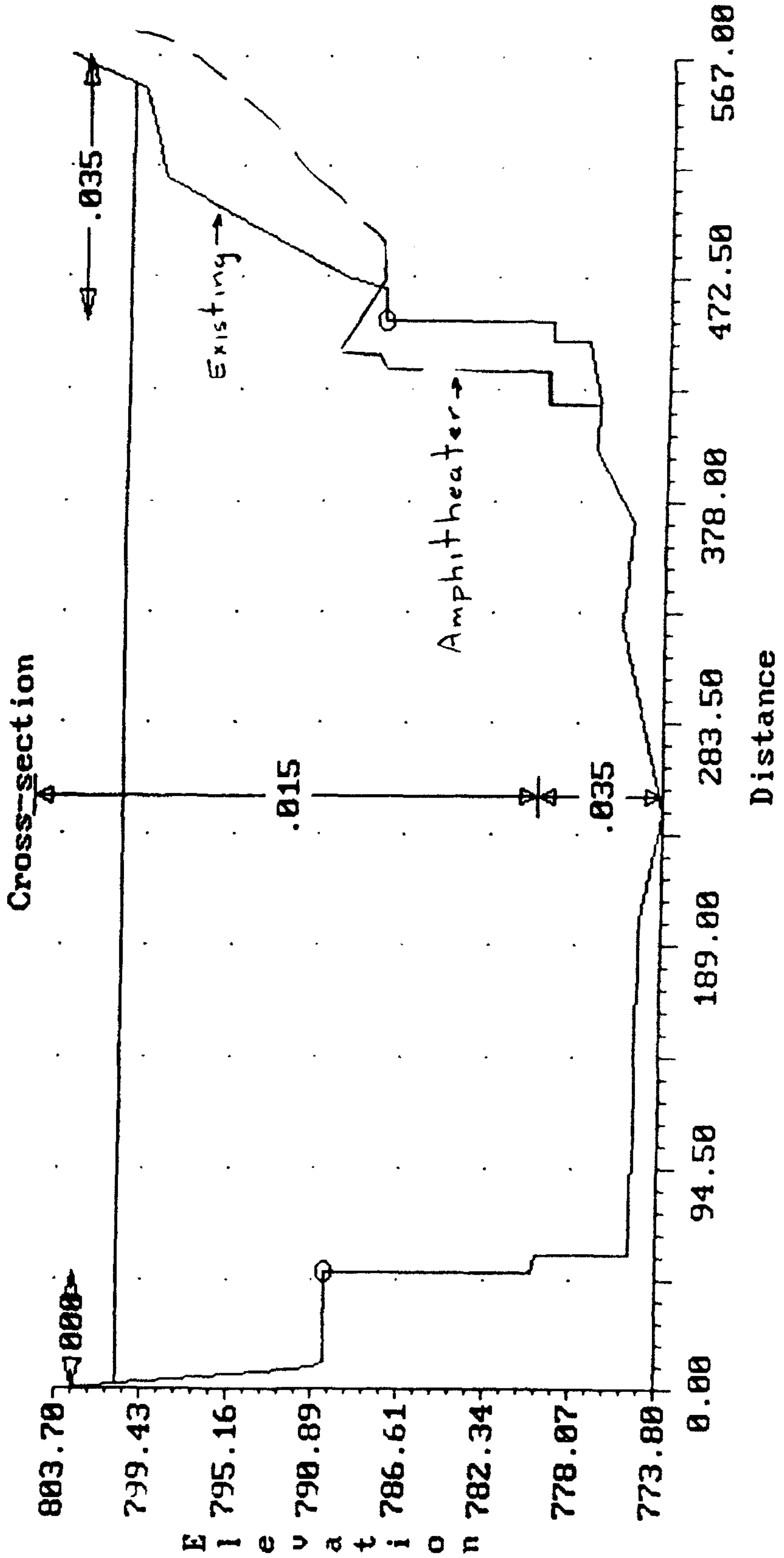
a. The amphitheater has a drainage area of 0.54 acres. Two drains direct storm runoff from the amphitheater to an existing interceptor sewer. Each drain has a runoff area of about 0.27 acres of sloping grass. The design appears on Drawing Plate 19. Water falls into a trench basin that is 6 inches deep and then enters a 4-inch diameter steel pipe that drains into a 48 inch diameter standard precast manhole. A 12 inch diameter reinforced concrete pipe leads from the manhole to the existing interceptor sewer.

b. The capacity of each drain is 0.77 cubic feet per second and is controlled by the 4-inch diameter steel pipe. This is a fairly large capacity and appears to be able to pass a storm with over a 10-year recurrence interval. The recurrence interval was determined by solving the rationals equation (Q=CIA) for hourly rainfall intensity (I). The hourly rainfall capacity was divided by 12 to determine the

maximum 5-minute duration rainfall and compared to published 5-minute duration values.

5. ELEVATION DURATION

a. Plate E-2 shows approximate profiles indicating the ordinary high water and the 12.5 percent duration elevation for the growing period in the study reach. The period of record used for these computations extended from 1969 to 1987.



Cross Section Showing
Amphitheater Encroachment

PLATE E-1

Des Moines River Elevation Duration Percent Exceedence for the Growing Season

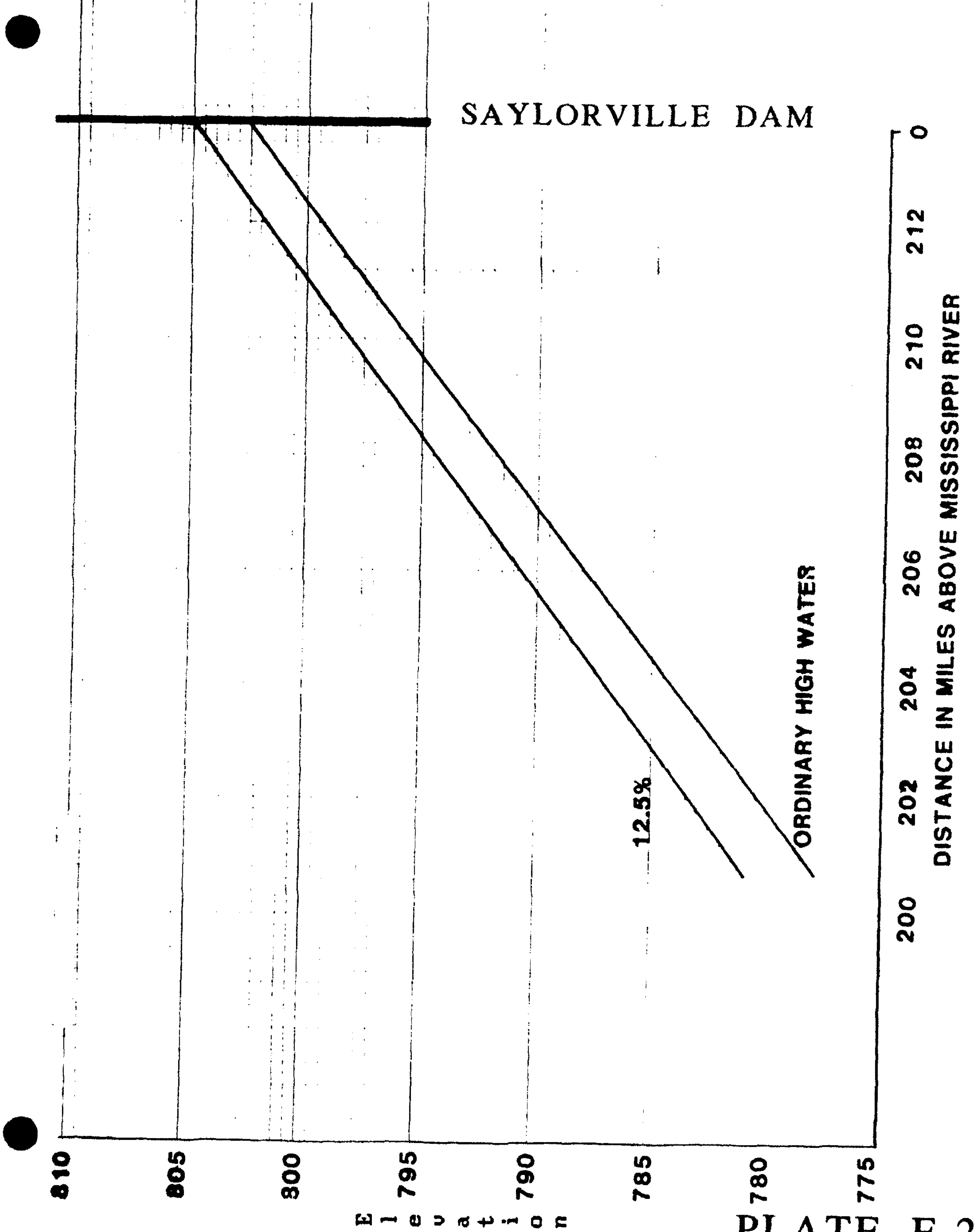


PLATE E-2

DISTRIBUTION

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DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM NO. 8
WITH ENVIRONMENTAL ASSESSMENT

DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER

DES MOINES, IOWA

APPENDIX F
DISTRIBUTION LIST

LAST NAME	FIRST NAME	ADDRESS	CITY, STATE	ZIP	REPORT	NOTICE

FEDERAL						

OFFICE OF ENV AFFAIRS; DEPT OF INTERIOR; MAIN INTERIOR BLDG, MS 2340;		1849 C ST, NW	WASHINGTON, D.C.	20240	12	0
ADV. COUNCIL HIST. PRES.	DIRECTOR	1100 PENNYSLVANIA AVE. NW.	WASHINGTON, D.C.	20004	1	0
BUREAU OF LAND MANAGEMENT	ATTN: LEON KABAT	P.O. BOX 631	MILWAUKEE, WI.	53201	1	0
CNTR. FOR DISEASE CON.	SPEC. PROGRAMS GRP., CEHIC (F29)	ATTN: KENNETH W. HOLT	ATLANTA, GA.	30333	1	0
CORPS OF ENGINEERS - CHICAGO	ATTN: MR. ERNIE SAUERMAN	P.O. BOX 7206	CHICAGO, IL	60606	1	0
FEDERAL HWY. ADMIN.	DIV. ADMINISTRATOR	P.O. BOX 627	AMES, IA.	50010	0	1
GRASSLEY	HONORABLE CHARLES E.		WASHINGTON, D.C.	20510	1	0
GRASSLEY	HONORABLE CHARLES E.	116 FEDERAL BUILDING	DAVENPORT, IA.	52801	1	0
HARKIN	HONORABLE TOM		WASHINGTON, D.C.	20510	1	0
HARKIN, HONORABLE TOM	733 FEDERAL BUILDING	210 WALNUT	DES MOINES, IA.	50309	1	0
LIGHTFOOT	HONORABLE JAMES ROSS	1222 LONGWORTH H.O.B.	WASHINGTON, D.C.	20515	1	0
LIGHTFOOT	HONORABLE JAMES ROSS	105 S. BUXTON	INDIANOLA, IA.	50125	1	0
NATIONAL PARK SERVICE	ATTN: JOHN SOWL	1709 JACKSON ST.	OMAHA, NE.	68102	0	1
SMITH	HONORABLE NEAL		WASHINGTON, DC.	20515	1	0
SMITH	HONORABLE NEAL	P.O. BOX 1748	AMES, IA.	50010	1	0
SMITH	HONORABLE NEAL	544 INSURANCE BUILDING	DES MOINES, IA.	50309	1	0
US FISH & WILDLIFE SERVICE	ATTN: RICHARD NELSON	1830 2ND AVE. - 2ND FLOOR	ROCK ISLAND, IL.	61201	1	0
US ENV. PROTECTION AGENCY	ATTN: LAWRENCE CAVIN, CHIEF	726 MINNESOTA AVE.	KANSAS CITY, KS.	66101	2	0
US GEOLOGICAL SURVEY, WRD	DISTRICT CHIEF	BOX 25046, MS 415	DENVER, CO.	80225	0	1

LAST NAME	FIRST NAME	ADDRESS	CITY, STATE	ZIP	REPORT	NOTICE
US GEOLOGICAL SURVEY	WATER RESOURCE DIV.	P.O. BOX 1230	IOWA CITY, IA.	52240	0	1
USDA SOIL CONS. SERVICE	ATTN: JAMES REEL	210 WALNUT ST.	DES MOINES, IA.	50309	1	0
WALNUT CREEK NWR	ATTN: DICK BIRGER	P.O. BOX 339	PRAIRIE CITY, IA.	50228	1	0
WATERWAYS EXPERIMENT STATION	ATTN: RESEARCH LIBRARY	P.O. BOX 6199	VICKSBURG, MS	39180	1	(AFTER APPROVAL)

ADVISORY COMMITTEE

1.SCHLENKER	RALPH	1283 FULTON AVE.	DES MOINES, IA.	50125	1	0
2.McCOY	DARLENE	2110 STORY STREET	BOONE, IA.	50036	1	0
3.IOWA DEPT OF NAT RESOURCES	ATTN: MR LARRY WILSON	WALLACE STATE OFFICE BLDG	DES MOINES, IOWA	50309	1	0
4.DALLAGER	LEE	1915 GRAND AVE.	DES MOINES, IA.	50309	1	0
5.HOOVER	RUTH	1403 W. 13TH ST. S.	NEWTON, IA.	50208	1	0
6.WOODWARD	RICHARD	RURAL ROUTE 5	BOONE, IA.	50036	1	0
7.O'BRIEN	MICHAEL	RURAL ROUTE 5	BOONE, IA.	50036	1	0
8.DALLAS CO. CONSERVATION DEPT	ATTN: JEFF LOGSDON	1477 K. AVENUE	PERRY, IA	50220	1	0
9.BOARD OF SUPERVISORS	CHAIRMAN	DALLAS CO. COURTHOUSE	ADEL, IA	50003	1	0
10.SCHEUERMAN	LINDA	RURAL ROUTE 1	STRATFORD, IA.	50249	1	0
11.HOLT	BRIAN	RR #1	WEBSTER CITY, IA	50595	1	0
12.BOARD OF SUPERVISORS	CHAIRMAN	JASPER COUNTY COURTHOUSE	NEWTON, IA.	50208	1	0
13.KEUNING	MAX	808 W. SECOND STREET	PRAIRIE CITY, IA	50228	1	0
14. WARRICK	JOE	RURAL ROUTE 3, BOX 225	OSKALOOSA, IA.	52577	1	0
15.BOARD OF SUPERVISORS	CHAIRMAN	MAHASKA CO. COURTHOUSE	OSKALOOSA, IA	52577	1	0
16.PRATHER	WILL	MARION COUNTY COURTHOUSE	KNOXVILLE, IA.	50138	1	0
17.FORD	EDWIN J.	RURAL ROUTE 1	OTLEY, IA	50214	1	0
18.BRANNAN, RICHARD	1000 TWO RUAN CENTER	601 LOCUST ST.	DES MOINES, IA.	50309	1	0
19.ALBERS	DAN	491 S.E. 72ND STREET	RUNNELS, IA	50237	1	0
20.RICHARDS	IVAN	349-228TH AVE.	HARTFORD, IA.	50118	1	0
21.GOODHUE	JIM	RURAL ROUTE 2	CARLISLE, IA	50047	1	0

LAST NAME	FIRST NAME	ADDRESS	CITY, STATE	ZIP	REPORT	NOTICE
22.SANDHOLM	SID	23 S. MAIN	DAYTON, IA.	50530	2	0
23.GROAT	MYRON	2735 20TH AVE. N.	FORT DODGE, IA.	50501	1	0
24.JORGENSEN, RIC	CITY HALL	E. 1ST & LOCUST	DES MOINES, IA.	50307	1	0
25.FOSTER	TOM	RR #4, BOX 89	OGDEN, IA.	50212	1	0
26.MAYOR	CITY OF CARLISLE	CITY HALL	CARLISLE, IA.	50047	1	0
27.McCARVILLE	HONORABLE MICHAEL D.	819 1ST AVE. SOUTH	FORT DODGE, IA.	50501	1	0
28.PARIS	MIKE	RURAL ROUTE 4	BOONE, IA.	50036	1	0
29.MAYOR	CITY OF HARTFORD	CITY HALL	HARTFORD, IA.	50118	1	0
30.MAYOR	CITY OF HARVEY	CITY HALL	HARVEY, IA	50119	1	0
31.PAEZ	MARY JANE	6165 CRABAPPLE LANE	JOHNSTON, IA.	50131	1	0
32.CUNNINGHAM	MIKE	1102 E. COMPETINE	KNOXVILLE, IA	50138	1	0
33.LARSON	LARRY	425 E. HILL ST.	LEHIGH, IA.	50557	1	0
34.MAYOR	CITY OF MADRID	CITY HALL	MADRID, IA.	50156	1	0
35.BELL	STEVEN	P.O. BOX 345	PELLA, IA	50219	1	0
36.MAYOR	CITY OF PILOT MOUND	CITY HALL	PILOT MOUND, IA	50223	1	0
37.FORBES	HONORABLE KENT M.	4450 OAKWOOD DR.	DES MOINES, IA.	50317	1	0
38.BURCH	WILLIAM	1201 BROADWAY, RR 1	POLK CITY, IA.	50226	1	0
39.HERING	JACK	P.O. BOX 89	RUNNELLS, IA.	50237	1	0
40.JOHNSON	DIXIE	507 TENNYSON RR1, BOX 139	STRATFORD, IA.	50249	1	0
41.MAYOR	CITY OF SWAN	CITY HALL	SWAN, IA	50252	1	0
42.DUNHAM	JAMES	920 DES MOINES ST.	WEBSTER CITY, IA	50595	1	0
43.OHMART	TED	1026 31ST ST.	W DES MOINES, IA.	50265	1	0
44.BLANCHAR	JAMES	CENCR-OD	ROCK ISLAND, IL	61201	1	0
45.KELLEY	ROBERT	CENCR-ED	ROCK ISLAND, IL	61204	1	0
46.HOUSACE	ATTN: MR. DARREL LEWIS	CENCW-OM	WASHINGTON, DC	20314	1	0

STATE

BRANSTAD	HONORABLE TERRY	STATE CAPITOL	DES MOINES, IA.	50139	1	0
BLACK	HONORABLE DENNIS	ROUTE 1, BOX 77	GRINNELL, IA.	50112	1	0
BLANSHAN	HONORABLE GENE	RURAL ROUTE, BOX 137	SCRANTON, IA.	51462	1	0
BUHR	HONORABLE FLORENCE D.	127 30TH ST.	DES MOINES, IA.	50310	1	0

LAST NAME	FIRST NAME	ADDRESS	CITY, STATE	ZIP	REPORT	NOTICE
CONNORS	HONORABLE JOHN H.	316 E 22ND ST.	DES MOINES, IA.	50317	1	0
DIELEMAN	HONORABLE WILLIAM W.	518 WOODLAWN DRIVE	PELLA, IA.	50219	1	0
GENTLEMAN	HONORABLE JULIA B.	2814 FOREST DR.	DES MOINES, IA.	50312	1	0
HALL	HONORABLE HURLEY	RURAL ROUTE BOX 174A	OXFORD JUNCTION, IA.	52323	1	0
HISLER	HONORABLE VICTOR A.	CITY HALL	WEBSTER CITY, IA.	50595	0	1
HAVERLAND	HONORABLE MARK A.	852 NW. 90TH PLACE	POLK CITY, IA.	50226	1	0
HOLVECK	HONORABLE JACK	2203 34TH ST.	DES MOINES, IA.	50310	1	0
IOWA DEPT. ECON. DEV.	DIV. OF COMMUNITY PROG.	200 E. GRAND AVE.	DES MOINES, IA.	50309	1	0
IOWA DEPT. OF NAT. RES.	ATTN: MR. AL FARRIS	WALLACE STATE OFC. BLDG.	DES MOINES, IA.	50319	0	1
IOWA DEPT. OF NAT. RES.	ATTN: WILDLIFE BUREAU	WALLACE STATE OFFICE BLDG.	DES MOINES, IA.	50319	1	0
IOWA DOT, PROG MGMT.	ATTN: G. GENE JONES	800 LINCOLN WAY	AMES, IA.	50010	1	0
IOWA DEPT. OF TRANSPORTATION	ATTN: NANCY BURNS	826 LINCOLN WAY	AMES, IA.	50010	1	0
IOWA WILDLIFE FEDERATION	ATTN: ROGER TUCKER	3125 DOUGLAS, SUITE 103	DES MOINES, IA.	50310	1	0
IOWA DEPT. SOIL CONS.	ATTN: MR. LYLE AGELL	STATE CAPITOL COMPLEX	DES MOINES, IA.	50319	1	0
KINLEY	HONORABLE GEORGE R.	5006 SW. 18TH ST.	DES MOINES, IA.	50315	1	0
LUNDBY	HONORABLE MARY A.	1240 14TH ST.	MARION, IA.	52302	1	0
MANN	HONORABLE THOMAS, JR.	4049 LOWER BEAVER RD.	DES MOINES, IA.	50315	1	0
MAYBEE	HONORABLE GEORGE F.	P.O. BOX 550	BOONE, IA	50036	1	0
METCALF	HONORABLE JANET	1803 79TH ST.	DES MOINES, IA.	50310	1	0
NYSTROM	HONORABLE JACK N.	115 CLINTON	BOONE, IA.	50036	1	0
OFC. OF THE GOVERNOR	ATTN: DOUGLAS GROSS	CAPITOL BUILDING	DES MOINES, IA.	50309	1	0
OFICE OF THE STATE ARCHEOLOGIST		UNIVERSITY OF IOWA	IOWA CITY, IA.	52242	0	1
PALMER	HONORABLE WILLIAM C.	1340 E. 33C ST.	DES MOINES, IA.	50317	1	0
PARKER	HONORABLE EDWARD G.	ROUTE 1, BOX 128	MINGO, IA.	50168	1	0
RIORDAN	HONORABLE JAMES R.	BOX 11	WAUKEE, IA.	50263	1	0
READINGER	HONORABLE DAVID M.	5417 AURORA #139	DES MOINES, IA.	50310	1	0
RUNYAN	HONORABLE LARRY	MAYOR	STRATFORD, IA.	50249	0	1
SCHWENGELS	HONORABLE FORREST V.	ROUTE 2, BOX 408	FAIRFIELD, IA.	52556	1	0
SOORHOLTZ	HONORABLE JOHN E.	RURAL ROUTE	MELBOURNE, IA.	50162	1	0
SCHRADER	HONORABLE DAVE	RURAL ROUTE 2	MONROE, IA	50170	1	0
SHERZAN	HONORABLE GARY	4004 15TH ST.	DES MOINES, IA.	50313	1	0
SKOW	HONORABLE BOB	604 DIVISION ST.	GUTHRIE CENTER, IA.	50115	1	0
SECRETARY OF AGRICULTURE	ATTN: MR. DALE COCHRANY	CAPITOL BUILDING	DES MOINES, IA.	50319	1	0
SOIL CONS. SERVICE	STATE CONSERVATIONIST	210 WALNUT ST.-693 FED BLGD	DES MOINES, IA.	50309	1	0

LAST NAME	FIRST NAME	ADDRESS	CITY, STATE	ZIP	REPORT	NOTICE
STATE HIST. PRES. OFFICER	HISTORICAL BUILDING	E. 12TH & GRAND AVE.	DES MOINES, IA.	50319	1	0
VAN MAANEN	HONORABLE HAROLD	RURAL ROUTE 5	OSKALOOSA, IA.	52577	1	0
WILDLIFE RESEARCH STATION	ATTN: DICK MCWILLIAMS	RR 1	BOONE, IA.	50036	1	0

LOCAL						

AREA XV REG. PLAN. COMM.	ATTN: ELLEN FOUDREE, DIR.	P.C. BOX 1110	OTTUMWA, IA.	52501	0	1
BOARD OF SUPERVISORS		HAMILTON COUNTY COURTHOUSE	WEBSTER CITY, IA.	50595	1	0
BOARD OF SUPERVISORS		JASPER COUNTY COURTHOUSE	NEWTON, IA.	50208	1	0
BOARD OF SUPERVISORS		MAHASKA COUNTY COURTHOUSE	OSKALOOSA, IA.	52577	1	0
BOARD OF SUPERVISORS	ATTN: WILL PRATHER	MARION COUNTY COURTHOUSE	KNOXVILLE, IA.	50138	1	0
BOARD OF SUPERVISORS		POLK COUNTY COURTHOUSE	DES MOINES, IA.	50307	1	0
BOARD OF SUPERVISORS	WARREN CO. COURTHOUSE	P.O. BOX 297	INDIANOLA, IA.	50125	1	0
CENTRAL IOWA	TOURISM REGION	P.O. BOX 1491	NEWTON, IA	50208	0	1
CITY HALL	ATTN: DON COATES	P.O. BOX 410	JOHNSTON, IA.	50131	1	0
CITY CLERK	ATTN: GERALDINE CONKLIN	P.O. BOX 218	STRATFORD, IA.	50249	1	0
DEPT. OF PARKS & REC	MR. GARY SCOTT	217 5TH STREET	W DES MOINES, IA	50265	0	1
DES MOINES PARKS & REC	ATTN: MR. STEVE DRAKE	3226 UNIVERSITY AVE.	DES MOINES, IA.	50311	1	0
DES MOINES REGISTER	ATTN: PERRY BEMAN	P.O. BOX 957	DES MOINES, IA	50304	1	0
DIRECTOR	ADEL PUBLIC LIBRARY	820 PRAIRIE	ADEL, IA.	50003	1	0
DIRECTOR	ALTOONA PUBLIC LIBRARY	700 1ST AVE. S.	ALTOONA, IA.	50009	1	0
DIRECTOR	BONDURANT COMMUNITY LIBRARY	103 MAIN S.E.	BONDURANT, IA.	50035	1	0
DIRECTOR	CALLENDER LIBRARY	THOMAS ST.	CALLENDER, IA.	50523	1	0
DIRECTOR	CARLISLE LIBRARY	135 SCHOOL ST., BOX S	CARLISLE, IA.	50047	1	0
DIRECTOR	COLFAX LIBRARY	WALNUT & LOCUST	COLFAX, IA.	50045	1	0
DIRECTOR	COWLES LIBRARY	25TH & UNIVERSITY	DES MOINES, IA.	50311	1	0
DIRECTOR	DALLAS CENTER LIBRARY	150 WALNUT	DALLAS CENTER, IA.	50063	1	0
DIRECTOR	DAYTONA LIBRARY		DAYTON, IA.	50530	1	0
DIRECTOR	DE SOTO PUBLIC LIBRARY	410 E. WALNUT	DE SOTO, IA.	50069	1	0
DIRECTOR	DES MOINES LIBRARY	100 LOCUST ST.	DES MOINES, IA.	50308	1	0
DIRECTOR	DES MOINES LIBRARY	1305 UNIVERSITY	DES MOINES, IA.	50314	1	0
DIRECTOR	DEXTER PUBLIC LIBRARY		DEXTER, IA.	50070	1	0

LAST NAME	FIRST NAME	ADDRESS	CITY, STATE	ZIP	REPORT	NOTICE
DIRECTOR	EDDYVILLE PUBLIC LIBRARY	BOX 348	EDDYVILLE, IA.	52553	1	0
DIRECTOR	ERICSON PUBLIC LIBRARY	702 GREENE ST.	BOONE, IA.	50036	1	0
DIRECTOR	FORT DODGE LIBRARY	605 1ST AVE. N.	FORT DODGE, IA.	50501	1	0
DIRECTOR	GEISLER LRC	CENTRAL COLLEGE	PELLA, IA.	50219	1	0
DIRECTOR	GOWRIE PUBLIC LIBRARY	1204 MARKET	GOWRIE, IA.	50543	1	0
DIRECTOR	GRIMES PUBLIC LIBRARY	213 S. MAIN	GRIMES, IA.	50111	1	0
DIRECTOR	INDIANOLA PUBLIC LIBRARY	106 W. BOSTON	INDIANOLA, IA.	50125	1	0
DIRECTOR	KIRKENDALL LIBRARY	410 W. 1ST ST.	ANKENY, IA.	50021	1	0
DIRECTOR	KNOXVILLE PUBLIC LIBRARY	213 E. MONTGOMERY	KNOXVILLE, IA.	50138	1	0
DIRECTOR	LEHIGH PUBLIC LIBRARY	MAIN STREET	LEHIGH, IA.	50557	1	0
DIRECTOR	MADRID PUBLIC LIBRARY	107 WEST 2ND STREET	MADRID, IA.	50156	1	0
DIRECTOR	MITCHELLVILLE LIBRARY	204 CENTER AVE. N.	MITCHELLVILLE, A.	50169	1	0
DIRECTOR	NEW SHARON LIBRARY	107 W. MAPLE	NEW SHARON, IA.	50207	1	0
DIRECTOR	NEWTON PUBLIC LIBRARY	400 AVE. W.	NEWTON, IA.	50211	1	0
DIRECTOR	OGDEN PUBLIC LIBRARY		OGDEN, IA.	50212	1	0
DIRECTOR	OSKALOOSA PUBLIC LIBRARY	301 S. MARKET STREET	OSKALOOSA, IA.	52577	1	0
DIRECTOR	PERRY PUBLIC LIBRARY	2ND & WILLIS	PERRY, IA.	50220	1	0
DIRECTOR	POLK CITY LIBRARY	P.O. BOX 249.	POLK CITY, IA.	50226	1	0
DIRECTOR	STRATFORD LIBRARY		STRATFORD, IA.	50249	1	0
DIRECTOR	CARNEGIE-VIERSEN PUB. LIBRARY	823 BROADWAY	PELLA, IA.	50219	1	0
DIRECTOR	WOODWARD LIBRARY	124 S. MAIN	WOODWARD, IA.	50276	1	0
FORT DODGE MESSENGER	ATTN: RUSS ROBERTS	P.O. BOX 659	FORT DODGE, IA.	50501	0	1
GOVT DOCS PROCESSING UNIT	ROOM 184, PARKS LIBRARY	IOWA STATE UNIV.	AMES, IOWA.	50011	1	0
HAMILTON	BOB	JESTER PARK	GRANGER, IA.	50109	1	0
SERV. DIR.		P.O. BOX 6450	JOHNSTON, IA.	50131	0	1
JIM HAMAN	MAYOR	P.O. BOX 218	STRATFORD, IA	50249	1	0
KNOXVILLE JOURNAL EXPRESS	ATTN: MS. CAROL ROLAND	P.O. BOX 458	KNOXVILLE, IA.	50138	1	0
KCCI-TV	ATTN: GREGG LAGAN	888 9TH, BOX 10305	DES MOINES, IA.	50306	1	0
KBOE RADIO		P.O. BOX 380	OSKALOOSA, IA.	52577	0	1
KWKY RADIO STATION		BOX 662	DES MOINES, IA.	50303	1	0
MAHASKA CO. CONS. BOARD	DIRECTOR	2254 - 200TH STREET	NEW SHARON, IA.	50207	1	0
MARION CO. CONS. BOARD	4TH FLOOR	MARION CO. COURTHOUSE	KNOXVILLE, IA	50138	1	0
MIDAS COUNCIL OF GOVRMT.	ATTN: MS. MYTRTLE PAYNE	200 N. 10TH ST. - W SIDE	FORT DODGE, IA.	50501	1	0
MARION COUNTY NEWS	MANAGING EDITOR	114 E. MONROE	PLEASANTVILLE, IA.	50225	1	0

LAST NAME	FIRST NAME	ADDRESS	CITY, STATE	ZIP	REPORT	NOTICE
OSKALOOSA HERALD		P.O. BOX 530	OSKALOOSA, IA.	52577	1	0
PARK, REC, & FORESTRY DEPT	ATTN: MARLO BRANDERHORST	CITY HALL	FORT DODGE, IA.	50501	1	0
THE LIBRARIES	DOCUMENTS DEPARTMENT	COLORADO STATE UNIVERSITY	FORT COLLINS, CO.	80523	1	0
THE REGISTER-NEWS		102 S. MAIN ST.	MADRID, IA.	50156	1	0
UNIVERSITY OF NORTHERN IA.	AL EHLEY, BIOLOGY DEPT.		CEDAR FALLS, IA.	50614	0	1

PRIVATE GROUPS/INDIVIDUALS

LAST NAME	FIRST NAME	ADDRESS	CITY, STATE	ZIP	REPORT	NOTICE
BAR "G" RANCH	ATTN: FEROLD GRANT	2376 FILLMORE ST.	SWAN, IA.	50252	1	0
DES MOINES ROWING CLUB	ATTN: JEFFREY DODGE	P.O. BOX 37363	HONOLULU, HI	96837	0	1
GILBERT	DR. WILLIAM H.	701 N. C	INDIANOLA, IA.	50125	0	1
GREATER PEORIA CONTRACTORS		512 W. MAIN ST.	PEORIA, IL.	61606	0	1
GREEN	JAMES M.	411 TONAWANDA DRIVE	DES MOINES, IA	50312	0	1
HLKB ARCHITECTURE	ATTN: MR. CAL LEWIS	FLEMING BLDG., SUITE 202	DES MOINES, IA	50309	5	0
IZAAK WALTON LEAGUE	ATTN: MR. LARRY HUTCHINSON	4343 VALLEY DRIVE	DES MOINES, IA	50315	0	1
KOPP	MARK	722 18TH ST. APT. #12	DES MOINES, IA	50316	0	1
LEROY	DICK	2500 HOLCOMB AVE.	DES MOINES, IA	50310	0	1
MILLER	CHARLEY	RR #2, KENNEDY PARK	FORT DODGE, IA.	50501	1	0
NORRIS	MIKE	819 1ST AVE. S.	FORT DODGE, IA.	50501	1	0
PELLA VOLKSWEG	ATTN: FRED KREYKES	707 MAIN ST.	PELLA, IA.	50219	0	1
PRATT	LEROY G.	317 S.W. 42ND STREET	DES MOINES, IA	50312	1	0
STANLEY CONSULTANTS	ATTN: MR. ED SLATTERY	100 CT. AVE., SUITE 240	DES MOINES, IA	50309	0	1
VEENSTRA & KIM, INC.,	JOHN KURSITIS	300 W BANK BLDG 1601 22 STW	DES MOINES, IA	50265	1	0
WEBBS COUNTRY CAMPING	ATTN: DALE WEBB	2312 CARPENTER PL.	HARTFORD, IA.	50118	1	0
ZINGSHEIM	PATRICIA	E. 1ST & DES MOINES ST.	DES MOINES, IA.	50307	6	0

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INTERNAL

- - - - -

OFFICE	REPORT	NOTICE
DE	1	0
DP	1	0
ED	1	0
ED-DG	1	0
ED-C	1	0
ED-G	1	0
ED-N	1	0
PD	1	0
PD-C	1	0
PD-E	1	0
OD	1	0
OD-R	1	0
OC	1	0
PA	1	0
PO	1	0
PP-M	1	0
RE	1	0
IM-CL	3	0

DES MOINES RECREATIO

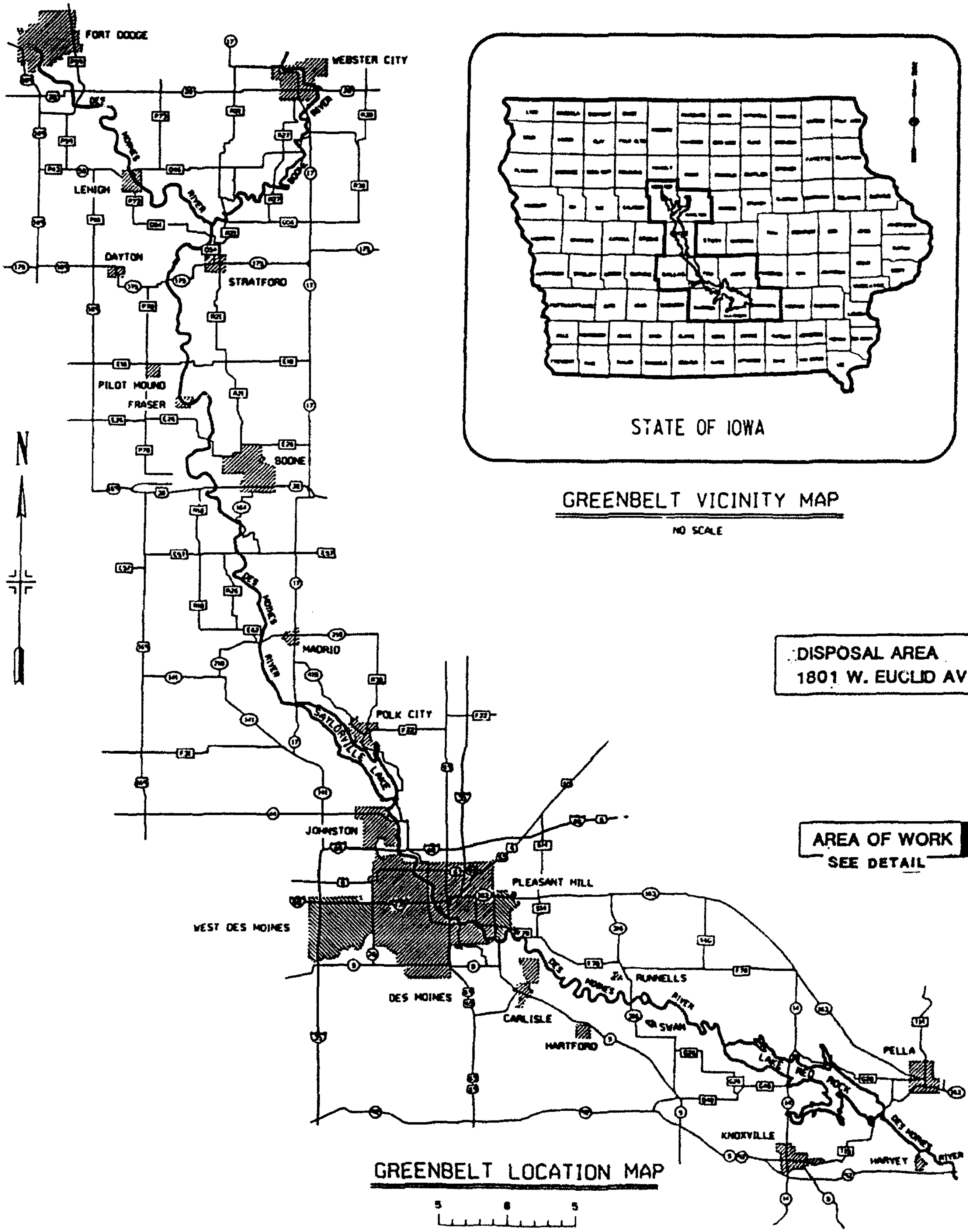
DOWNTOWN RIVERFRON

GREENBELT VICINITY MAP

NO SCALE

DISPOSAL AREA
1801 W. EUCLID AVE.

AREA OF WORK
SEE DETAIL



GREENBELT LOCATION MAP

C

B

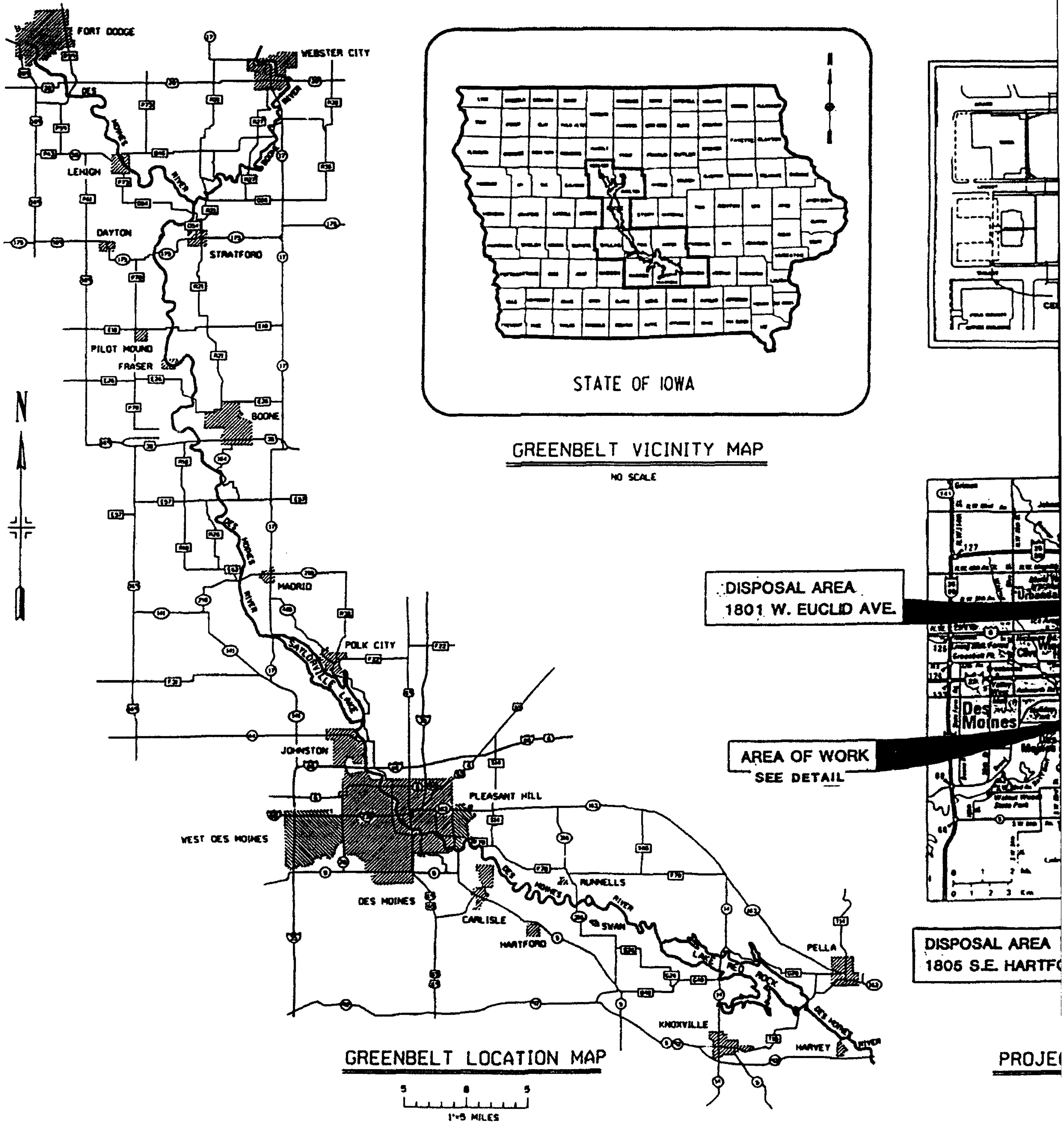
A

5

4

DES MOINES RECREATIONAL

DOWNTOWN RIVERFRONT PL



GREENBELT VICINITY MAP

NO SCALE

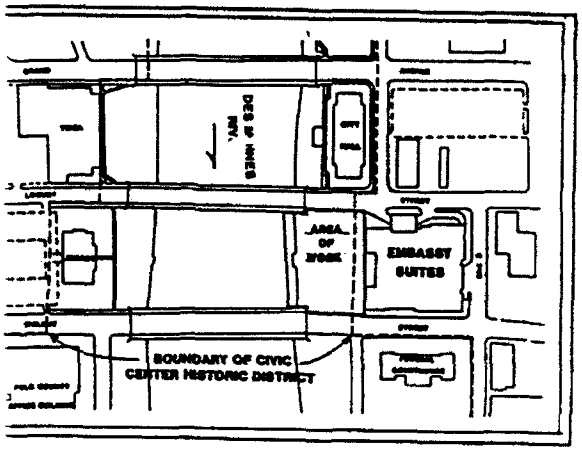
GREENBELT LOCATION MAP

1"=5 MILES

PROJE

5	4	3

AL RIVER AND GREENBELT
PLAZA/AMPHITHEATER



DETAIL

INDEX		
PLATE NO.	SHEET REF. NO.	TITLE OF DRAWING
1	X-1	VICINITY MAP, LOCATION PLAN, DETAIL AND INDEX
2	C-1	HYDRAULIC DATA I
3	C-2	HYDRAULIC DATA II
4	C-3	BORING LOGS
5	C-4	REFERENCE DRAWING - LEVEE PLAN AND PROFILE
6	C-5	GENERAL SITE PLAN (EXISTING CONDITIONS)
7	C-6	ELEVATION AND DETAILS OF EXISTING RIVERWALL
8	C-7	DEMOLITION PLAN AND DETAILS
9	A-1	PLAN VIEW
10	A-2	ELEVATION AND SECTIONS
11	S-1	STAGE AND RIVERWALK PLAN
12	S-2	STAGE AND RIVERWALK FOUNDATION
13	S-3	STAGE AND RIVERWALK CROSS-SECTIONS
14	S-4	ARCH ELEVATION
15	S-5	ARCH PLAN VIEW AND SUPPORT DETAIL
16	S-6	ARCH SIDE VIEW AND FOUNDATION
17	S-7	FLOODWALL / PLANTER BOX
18	S-8	T-WALL DETAILS
19	M-1	DRAINAGE AND IRRIGATION SITE PLAN
20	E-1	ELECTRICAL PLAN
21	E-2	ELECTRICAL DETAILS
22	E-3	ELECTRICAL DETAILS

PROJECT LOCATION PLAN

Revisions			
Symbol	Description	Date	Approved

SIGNATURES AFFIXED BELOW INDICATE OFFICAL RECOMMENDATION AND APPROVAL OF ALL DRAWINGS IN THIS SET AS INDICATED ON EACH INDIVIDUAL TITLE BLOCK

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Prepared by: U.S. ARMY ENGINEER DISTRICT, ROCK ISLAND
Submitted by: CHIEF, DESIGN BR.
CHIEF, HYDRAULICS BR.
CHIEF, GEOTECHNICAL BR.
Recommended by:
CHIEF, ENGINEERING DIV.
Approved by:
COL. CORPS OF ENGINEERS Date:

Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by: JOHN R. BROWN COL., CORPS OF ENGINEERS

US Army Corps of Engineers Rock Island District

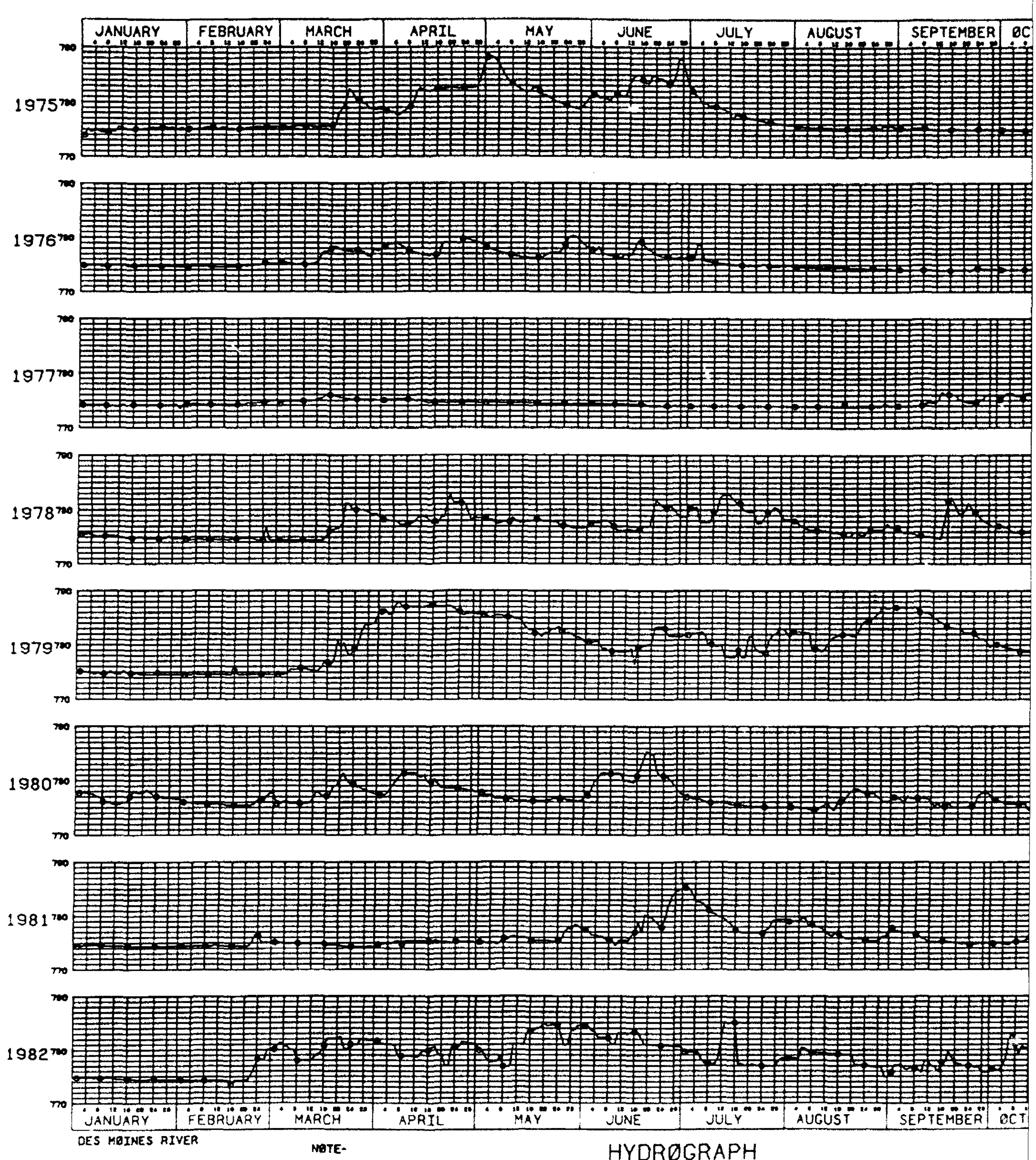
DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

VICINITY MAP, LOCATION PLAN, DETAIL AND INDEX

Scale: AS SHOWN
Date:
Drawing Code:
Sheet reference number: X-1
Solicitation Number:
Sheet 1 of

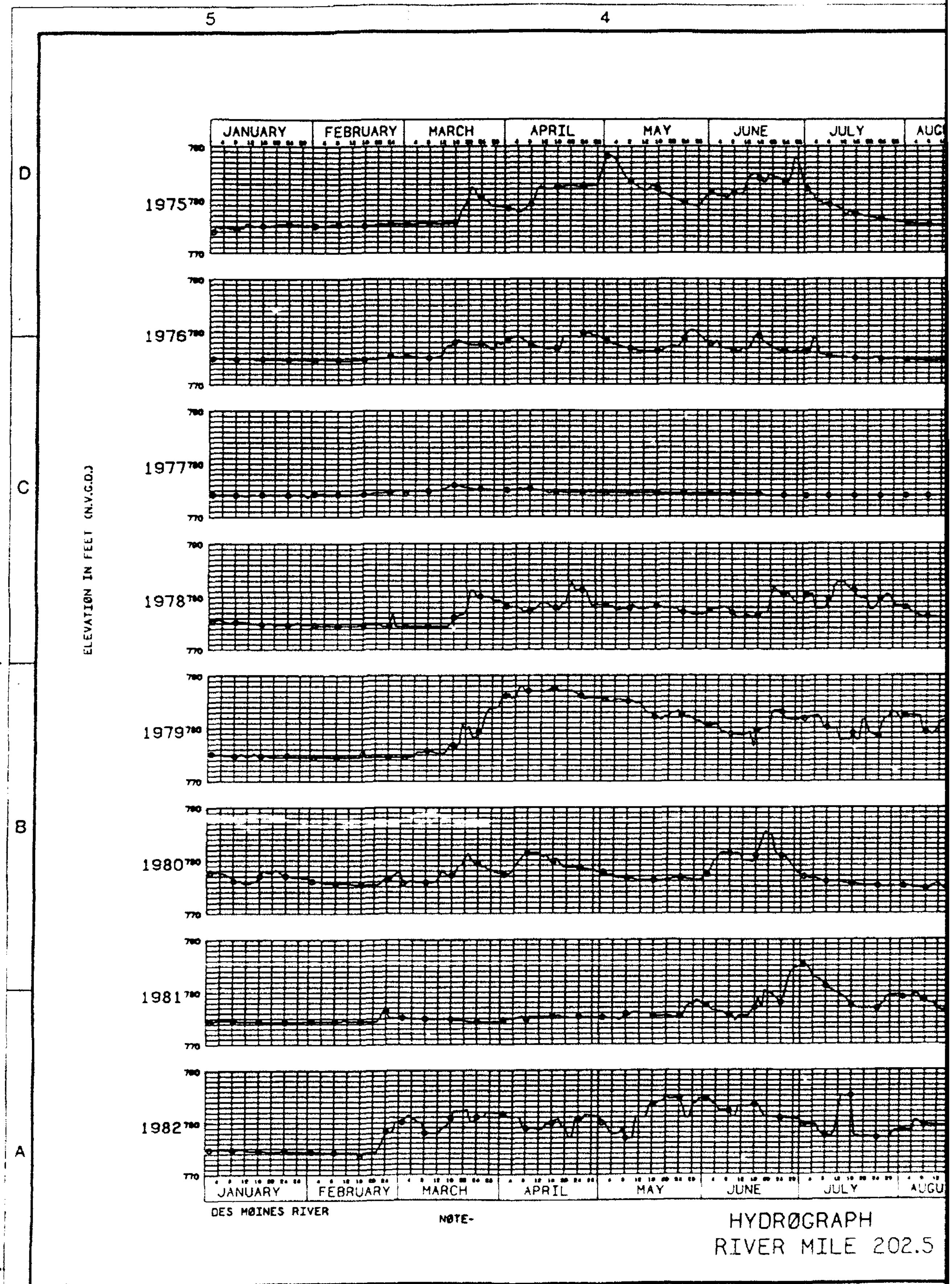
3 | 2 | 1

D C B A



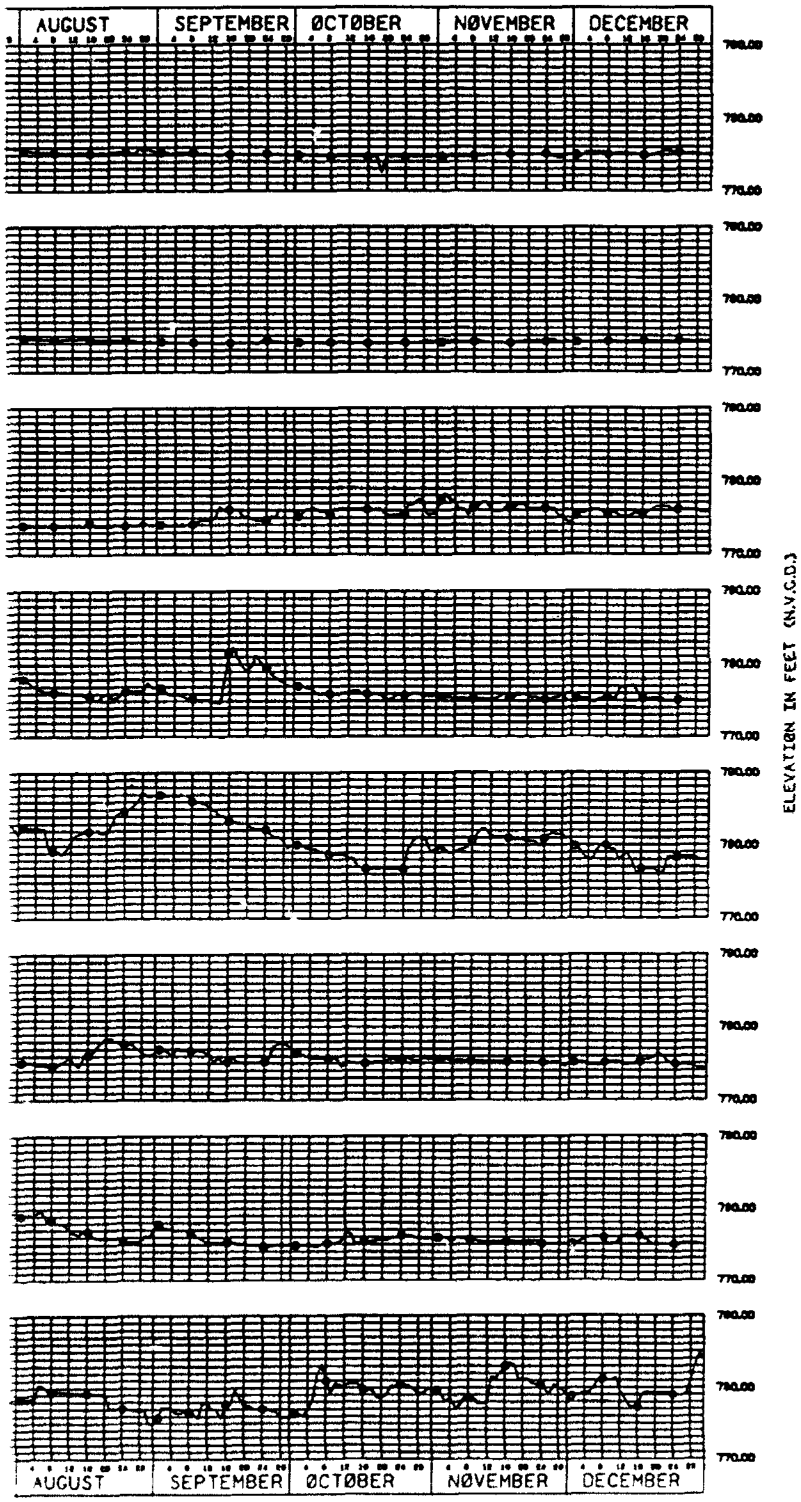
HYDROGRAPH
RIVER MILE 202.5

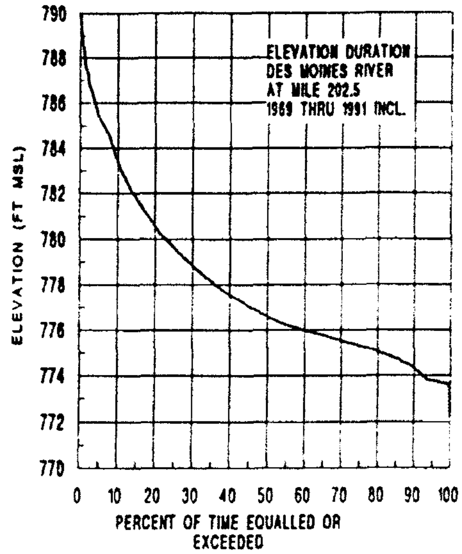
1063



HYDROGRAPH
RIVER MILE 202.5

3 | 2 | 1





)2.5

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

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Approved by:

US Army Corps of Engineers

DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

HYDRAULIC DATA I

Scale: AS SHOWN
Date:
Drawing Code:
Sheet reference number: C-1
Sheet _ of _

D C B A

3 | 2 | 1

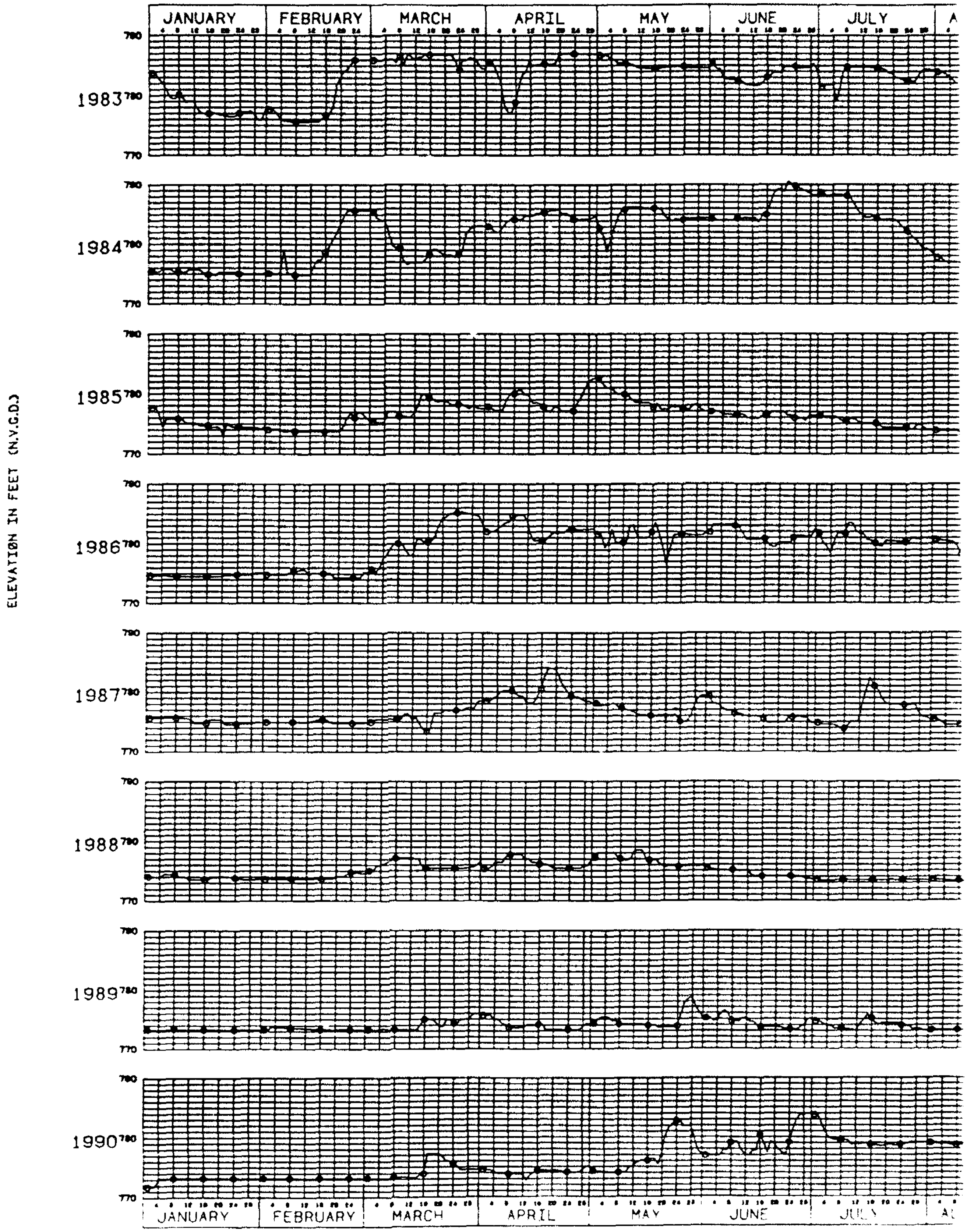
5 | 4

D

C

B

A



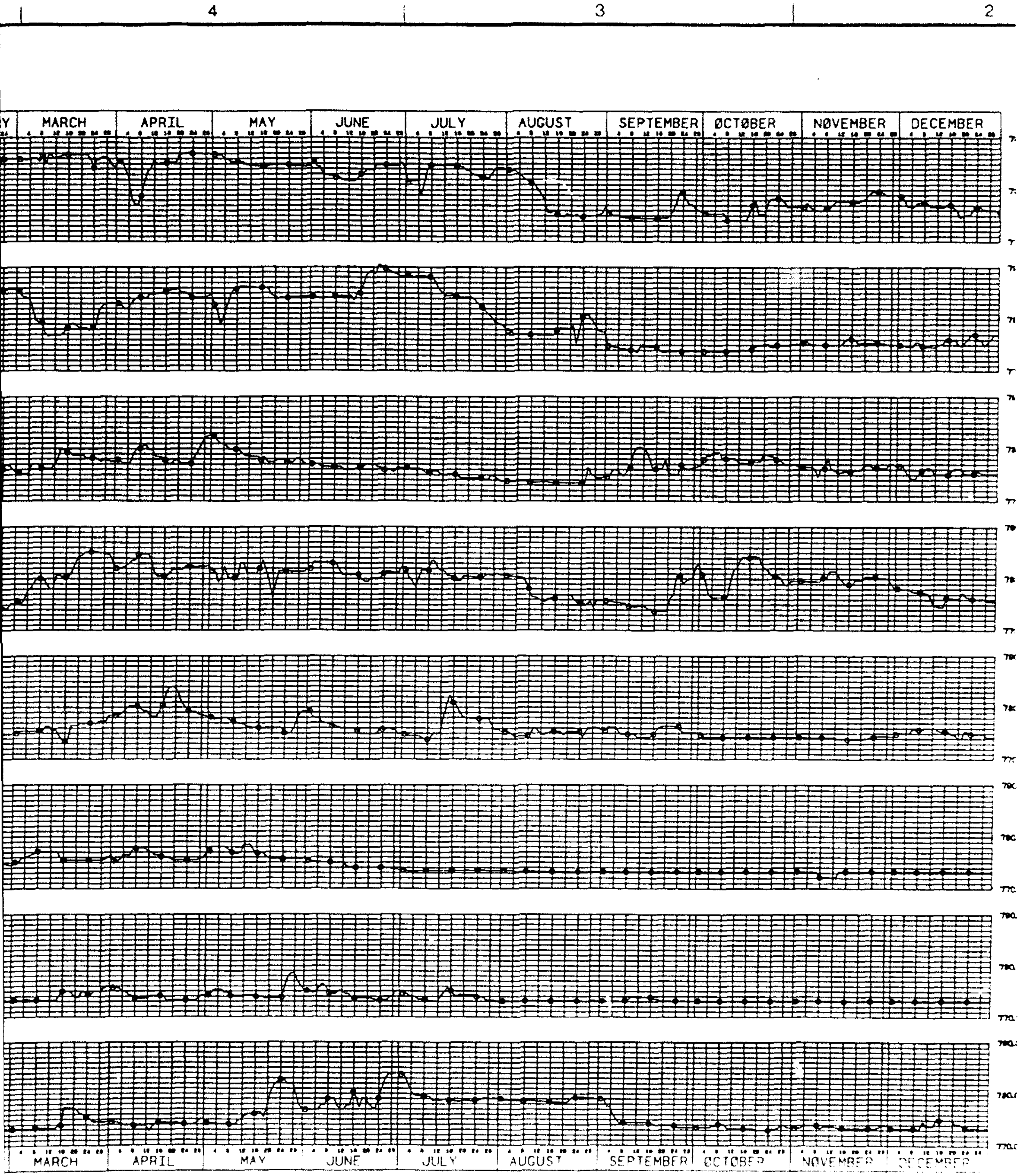
DES MOINES RIVER

NOTE-

HYDROGRAPH

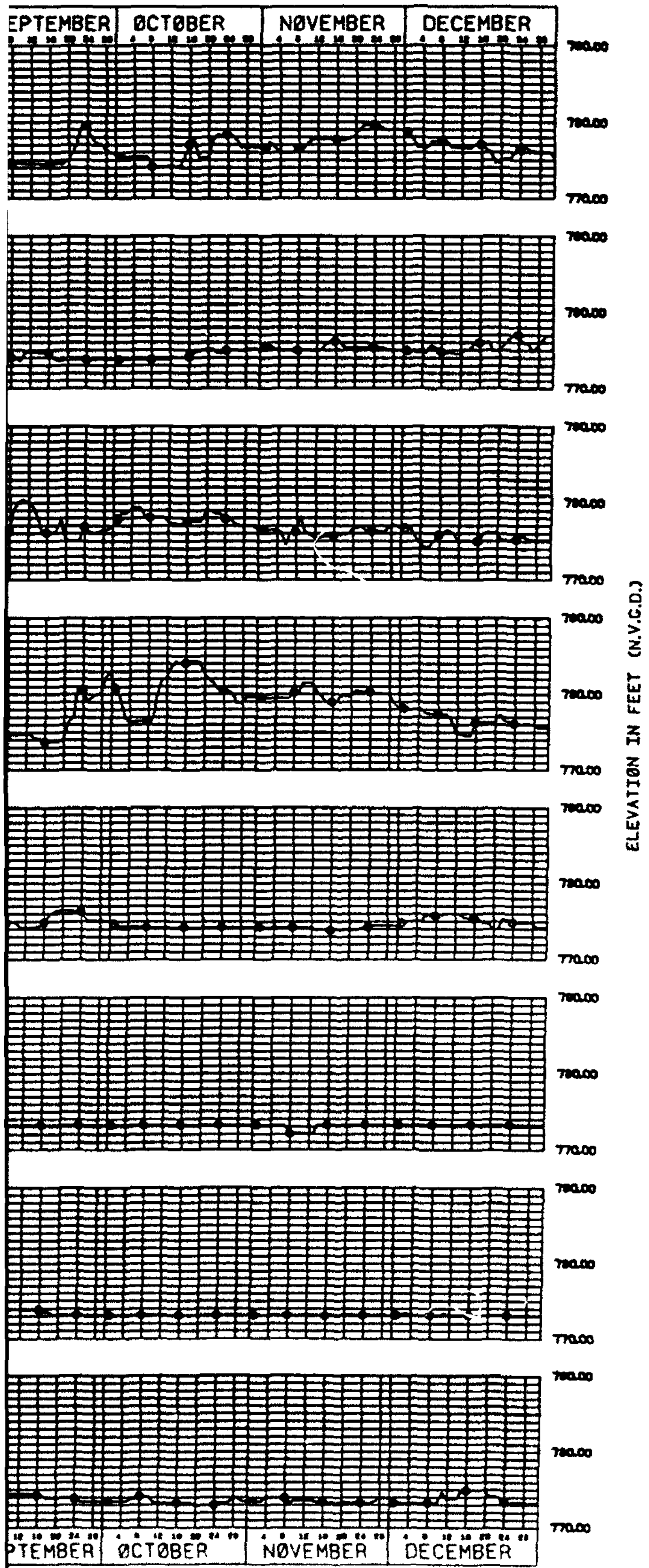
RIVER MILE 202.

5 | 4



HYDRØGRAPH
RIVER MILE 202.5

4 3



D

C

B

A

Revisions			
Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

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US Army Corps of Engineers

DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

HYDRAULIC DATA II

Scale: AS SHOWN

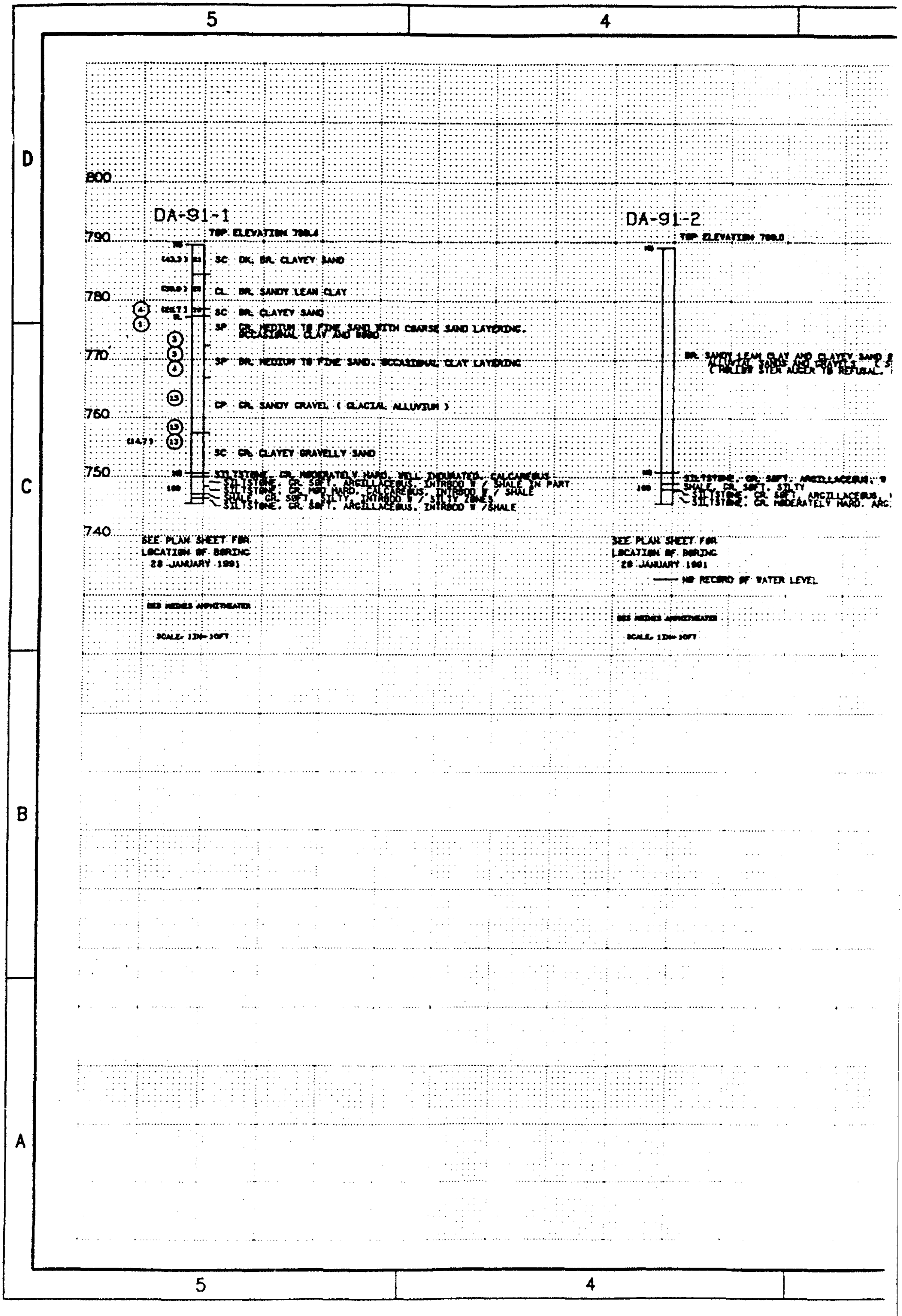
Date:

Drawing Code:

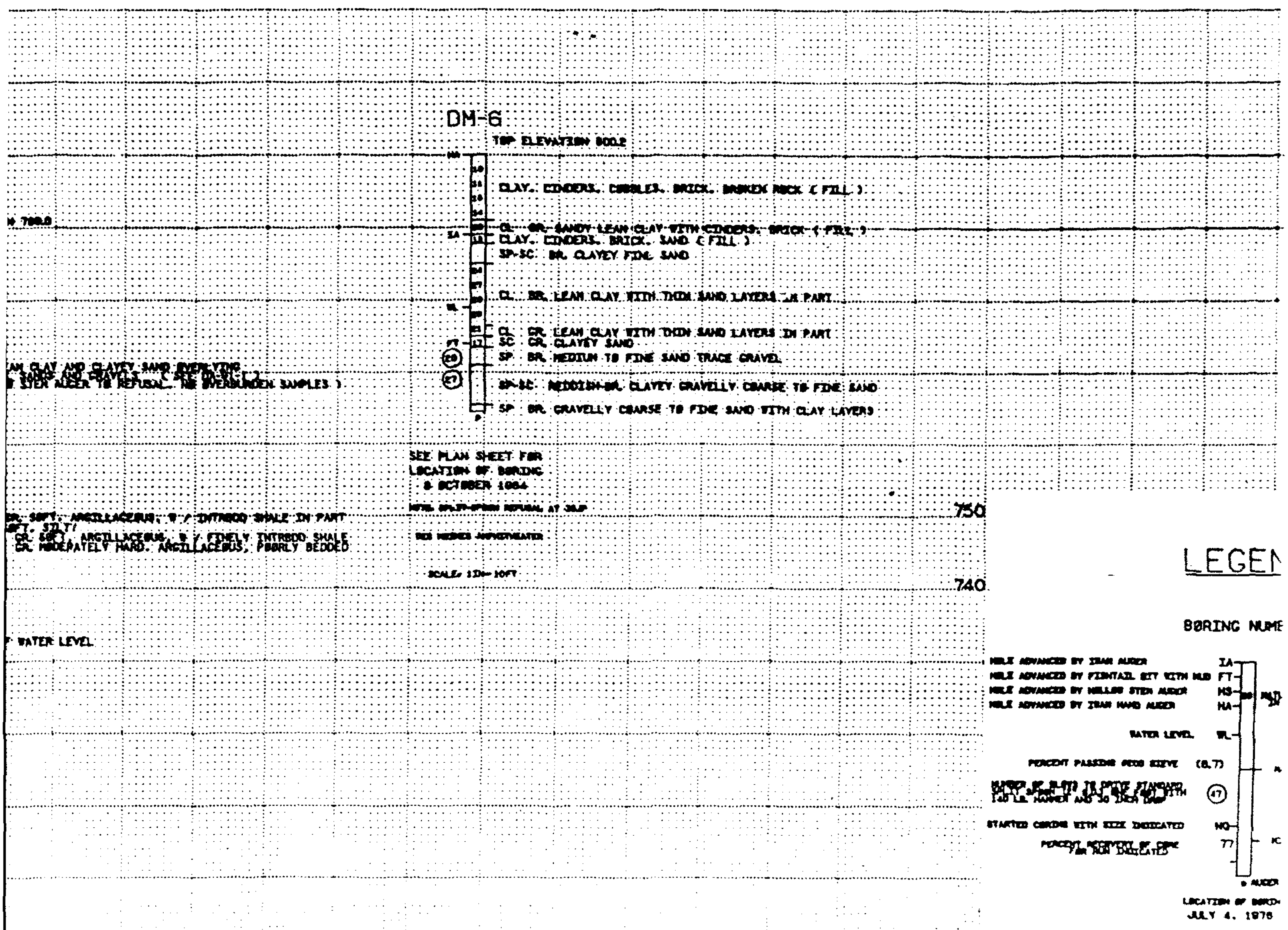
Sheet reference number: C-2

Sheet _ of _

313


5
4
D
C
B
A
800
790
780
770
760
750
740
DA-91-1
TØP ELEVATIØN 790.4
SC DK. BR. CLAYEY SAND
CL BR. SANDY LEAN CLAY
SC BR. CLAYEY SAND
SP GR. MEDIUM TØ FINE SAND WITH CØARSE SAND LAYERING. ØCCASIØNAL CLAY AND WØØD
SP BR. MEDIUM TØ FINE SAND. ØCCASIØNAL CLAY LAYERING
GP GR. SANDY GRAVEL (GLACIAL ALLUVIUM)
SC GR. CLAYEY GRAVELLY SAND
SILTSTØNE, GR. MØDERATELY HARD, WELL INDURATED, CALCAREØUS
SILTSTØNE, GR. SØFT, ARGILLACEØUS, INTRBDD W / SHALE IN PART
SILTSTØNE, GR. MØD HARD, CALCAREØUS, INTRBDD W / SHALE
SHALE, GR. SØFT, SILTY, INTRBDD W / SILTY ZØNES
SILTSTØNE, GR. SØFT, ARGILLACEØUS, INTRBDD W /SHALE
SEE PLAN SHEET FØR
LØCATIØN ØF BØRING
28 JANUARY 1991
DES MØINES AMPHITHEATER
SCALE, 1IN= 10FT
DA-91-2
TØP ELEVATIØN 790.0
SILTSTØNE, GR. SØFT, ARGILLACEØUS,
SHALE, GR. SØFT, SILTY
SILTSTØNE, GR. SØFT, ARGILLACEØUS,
SILTSTØNE, GR. MØDERATELY HARD, ARG.
SEE PLAN SHEET FØR
LØCATIØN ØF BØRING
28 JANUARY 1991
NØ RECØRD ØF WATER LEVEL
DES MØINES AMPHITHEATER
SCALE, 1IN= 10FT

1.13



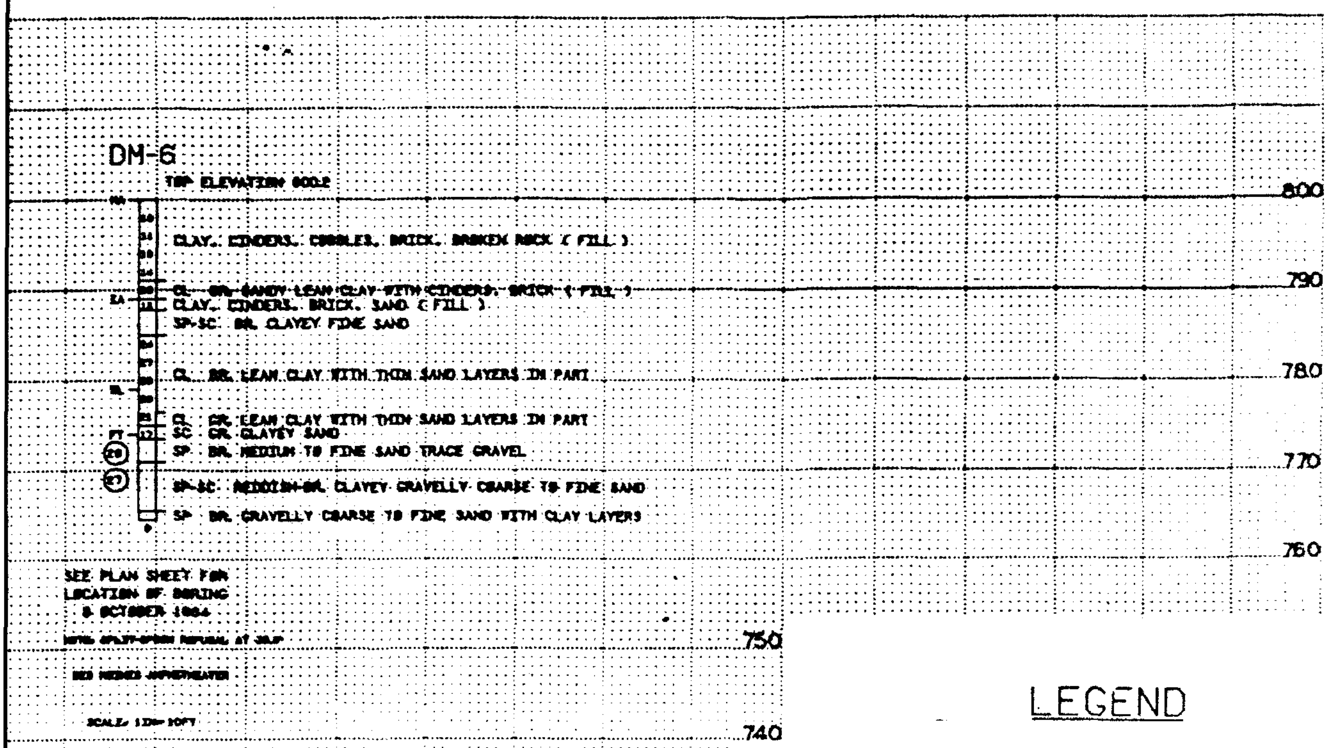
NOTES:

1. SEE PLATE 6 FOR LOCATION C
2. BORING DM-6 WAS DONE ON 8
PRIOR TO CONSTRUCTION OF GAT
OF THE LOCAL FLOOD PROTECTIO
ON PLATE 5.

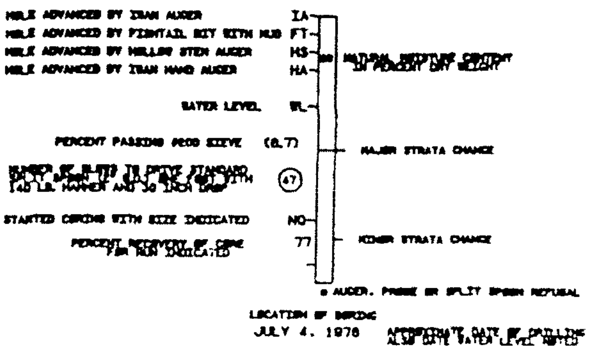
Revisions	
Symbol	Description

U.S. A
CC
RC

Designed by:	US Army Corps of Engineers — DES MOINES RECRE DOWNTO PLAZA/
Drawn by:	
Checked by:	BOI
Reviewed by:	Scale: AS SHOWN
	Date:
Approved by:	Drawing Code:



LEGEND



NOTES:

1. SEE PLATE 6 FOR LOCATION OF BORINGS.
2. BORING DM-6 WAS DONE ON 8 OCTOBER, 1964 PRIOR TO CONSTRUCTION OF GATEWELL D AS PART OF THE LOCAL FLOOD PROTECTION PROJECT SHOWN ON PLATE 5.

Revisions			
Symbol	Description	Date	Approved

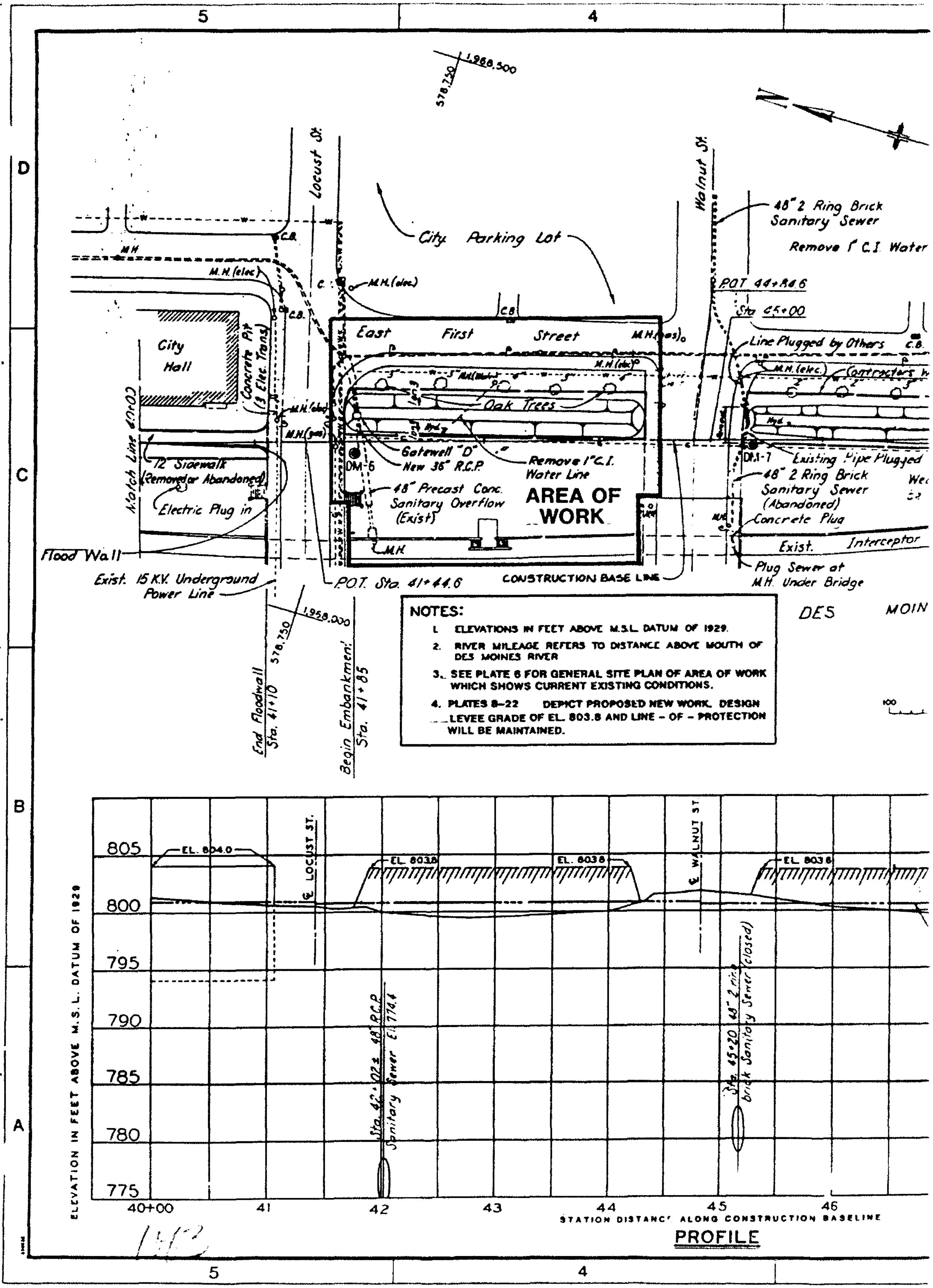
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

BORING LOGS

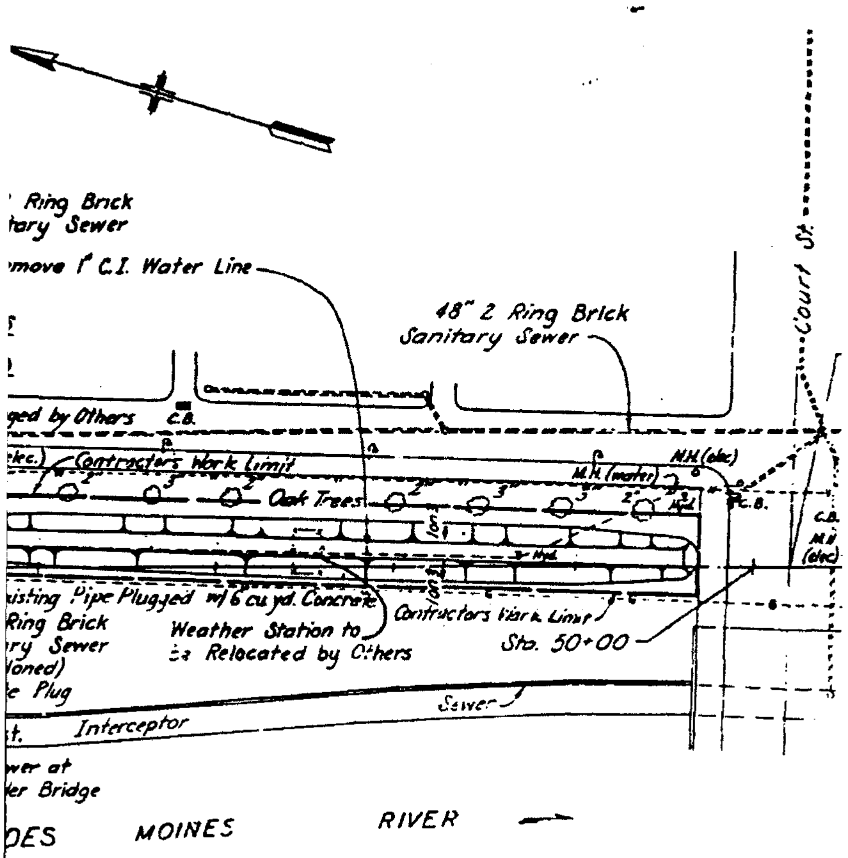
Designed by:			
Drawn by:			
Checked by:			
Reviewed by:	Scale: AS SHOWN	Sheet reference number:	Solicitation Number:
Approved by:	Date:	C-3	Sheet of
	Drawing Code:		

PLATE 4

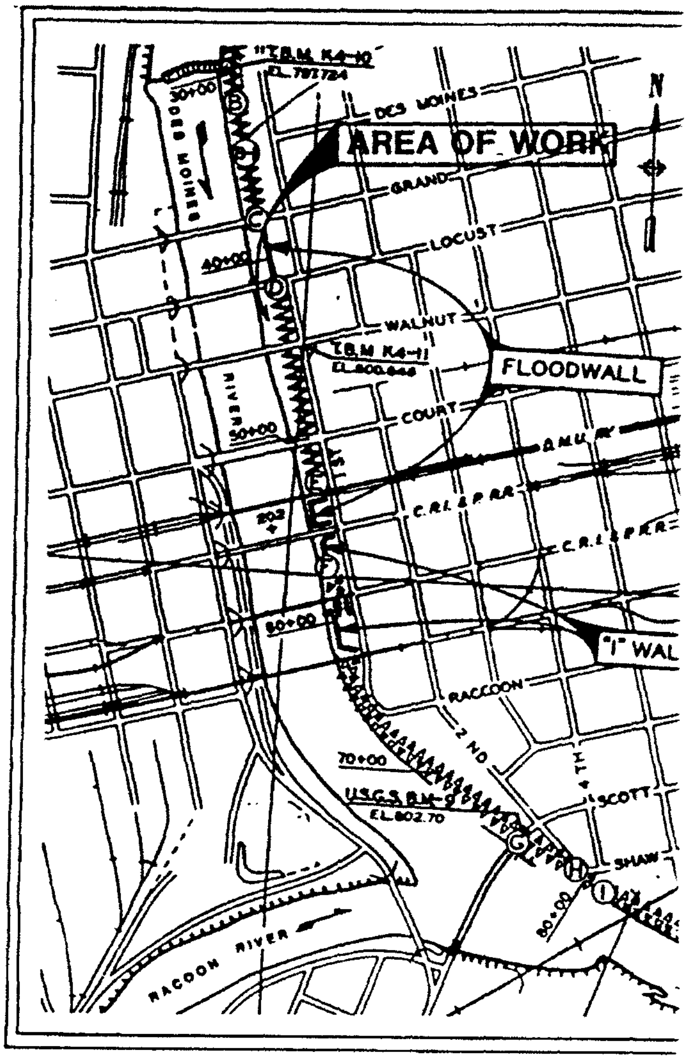


5
4
D
C
B
A
1,988,500
578,750
Locust St.
Walnut St.
48" 2 Ring Brick Sanitary Sewer
Remove 1" C.I. Water
City Parking Lot
M.H.
M.H. (elec)
C.B.
P.O.T. 44+84.6
Sta. 45+00
City Hall
Concrete Pit (3 Elec. Trans.)
East First Street
M.H. (gas)
Line Plugged by Others
M.H. (elec.)
Contractors
Oak Trees
Match Line 40+00
12" Sidewalk (Removed or Abandoned)
Electric Plug in
Gatewell "D"
New 36" R.C.P.
DM-6
Remove 1" C.I. Water Line
AREA OF WORK
DM-7
Existing Pipe Plugged
48" 2 Ring Brick Sanitary Sewer (Abandoned)
Concrete Plug
48" Precast Conc. Sanitary Overflow (Exist)
Flood Wall
Exist. Interceptor
Plug Sewer at M.H. Under Bridge
Exist. 15 K.V. Underground Power Line
P.O.T. Sta. 41+44.6
CONSTRUCTION BASE LINE
DES MOIN
1,958,000
578,750
End Floodwall Sta. 41+10
Begin Embankment Sta. 41+85
NOTES:
1. ELEVATIONS IN FEET ABOVE M.S.L. DATUM OF 1929.
2. RIVER MILEAGE REFERS TO DISTANCE ABOVE MOUTH OF DES MOINES RIVER
3. SEE PLATE 6 FOR GENERAL SITE PLAN OF AREA OF WORK WHICH SHOWS CURRENT EXISTING CONDITIONS.
4. PLATES 8-22 DEPICT PROPOSED NEW WORK. DESIGN LEVEE GRADE OF EL. 803.8 AND LINE - OF - PROTECTION WILL BE MAINTAINED.
100
EL. 804.0
EL. 803.8
EL. 803.8
EL. 803.8
℄ LOCUST ST.
℄ WALNUT ST.
805
800
795
790
785
780
775
Sta. 42+02± 48" R.C.P. Sanitary Sewer El. 774.4
Sta. 45+20 48" 2 ring brick Sanitary Sewer (closed)
ELEVATION IN FEET ABOVE M.S.L. DATUM OF 1929
40+00
41
42
43
44
45
46
STATION DISTANCE ALONG CONSTRUCTION BASELINE
PROFILE

3 2 1



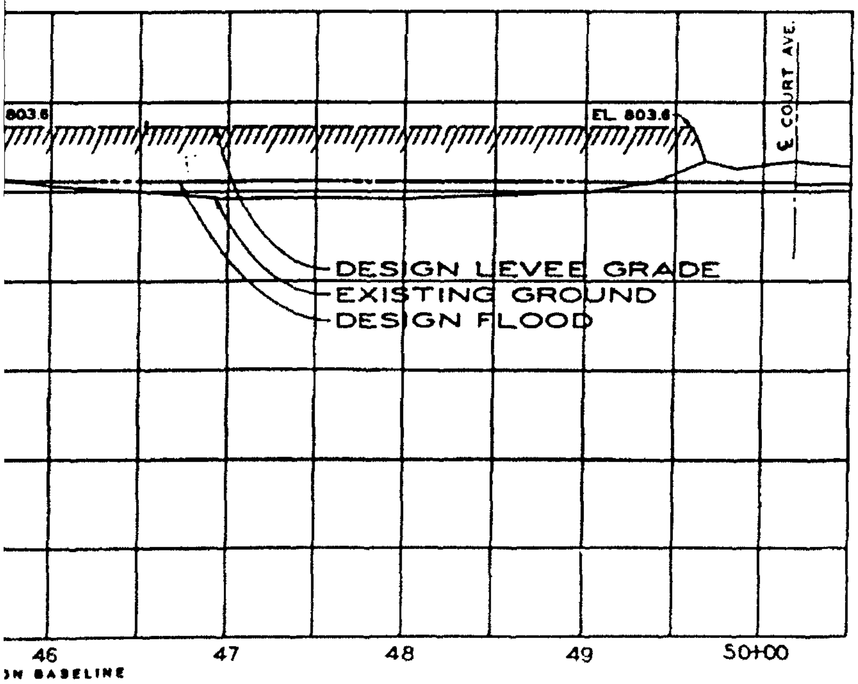
PLAN



VICINITY PLAN

LEGEND:

Ⓐ c



Symbol	Revisions Descriptions

U.S. ARMY ENGIN
CORPS OF E
ROCK ISLAND

Designed by:

Drawn by:

Checked by:

Reviewed by:

Approved by:

DES MOINES RECREATIONAL RIVER
DOWNTOWN RIVERF
PLAZA/AMPHITHE

REFERENCE DR
LEVEE PLAN AND

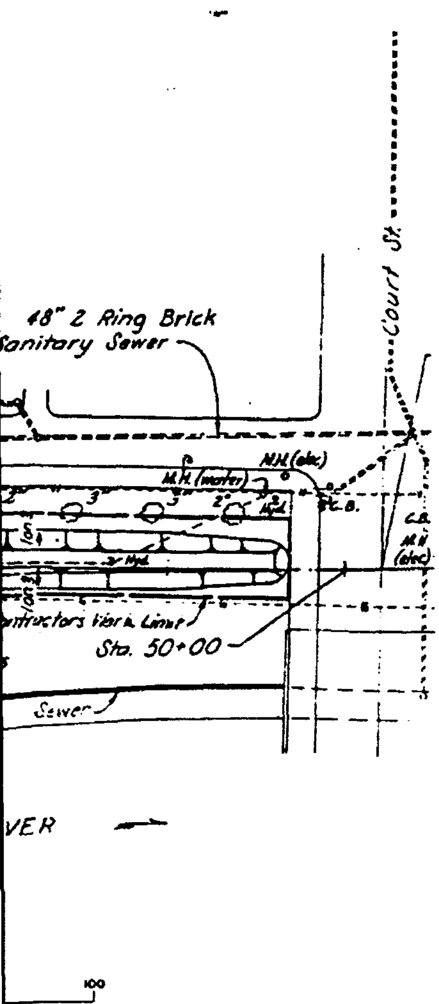
Scale: AS SHOWN

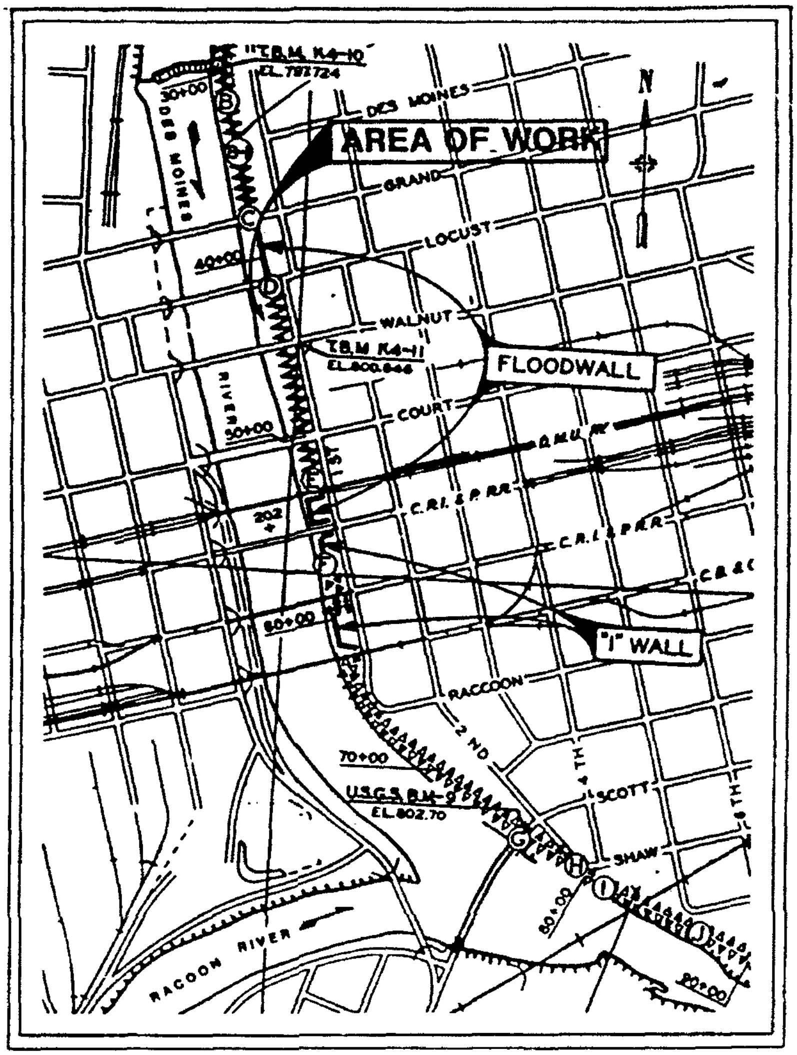
Date:

Drawing Code:

Sheet reference number: C-4

3 2 1





VICINITY PLAN

LEGEND:

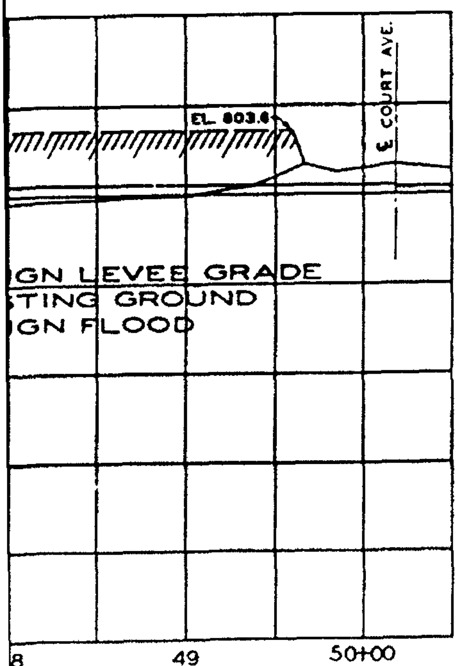
Ⓐ GATEWELL

EXISTING LEVEE

IMPROVED LEVEE

FLOODWALL

SCALE IN FEET



Symbol	Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

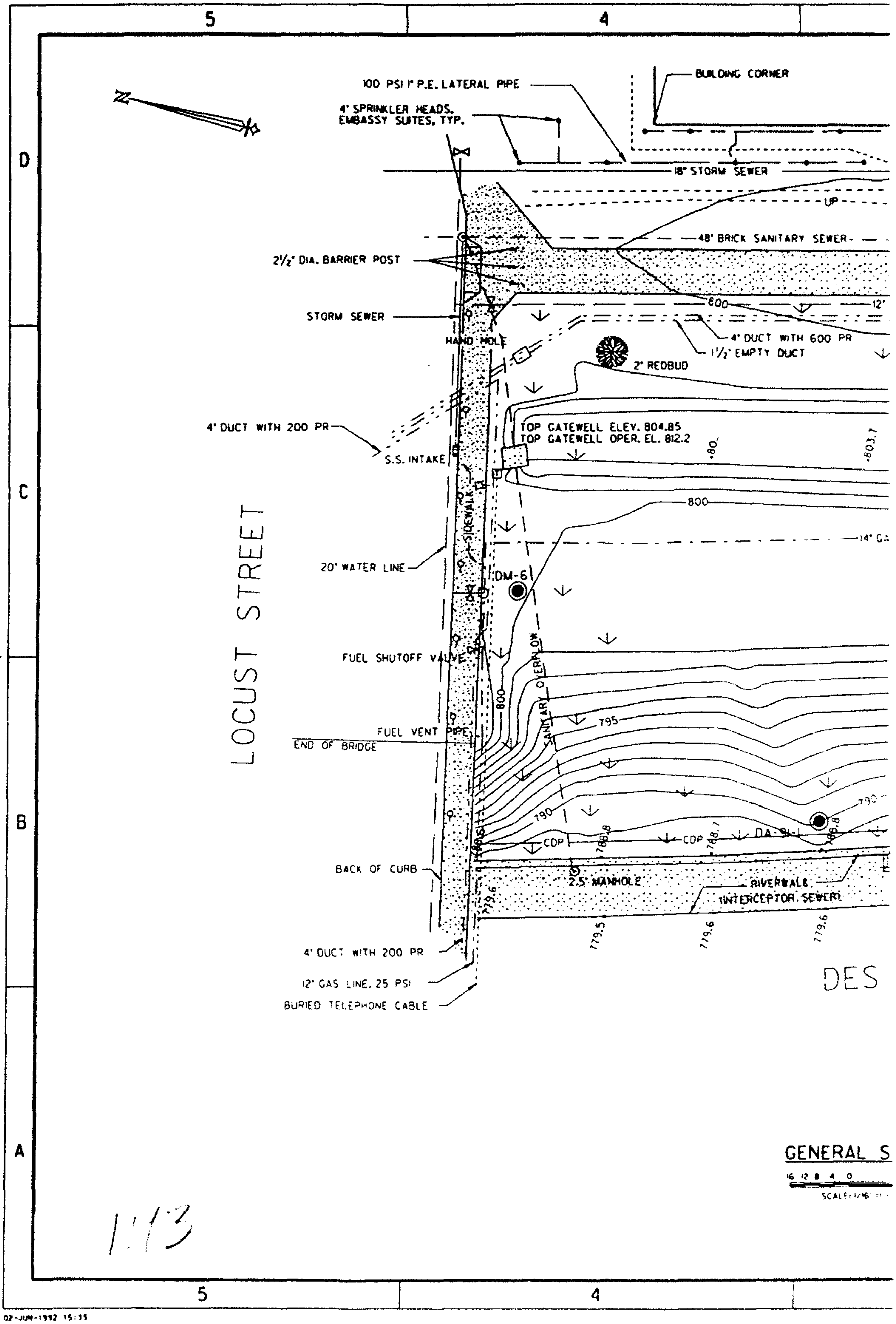
Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by:

DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

REFERENCE DRAWING
LEVEE PLAN AND PROFILE

Scale: AS SHOWN
Date:
Drawing Code:
Sheet reference number: C-4
Sheet __ of __

PLATE 5



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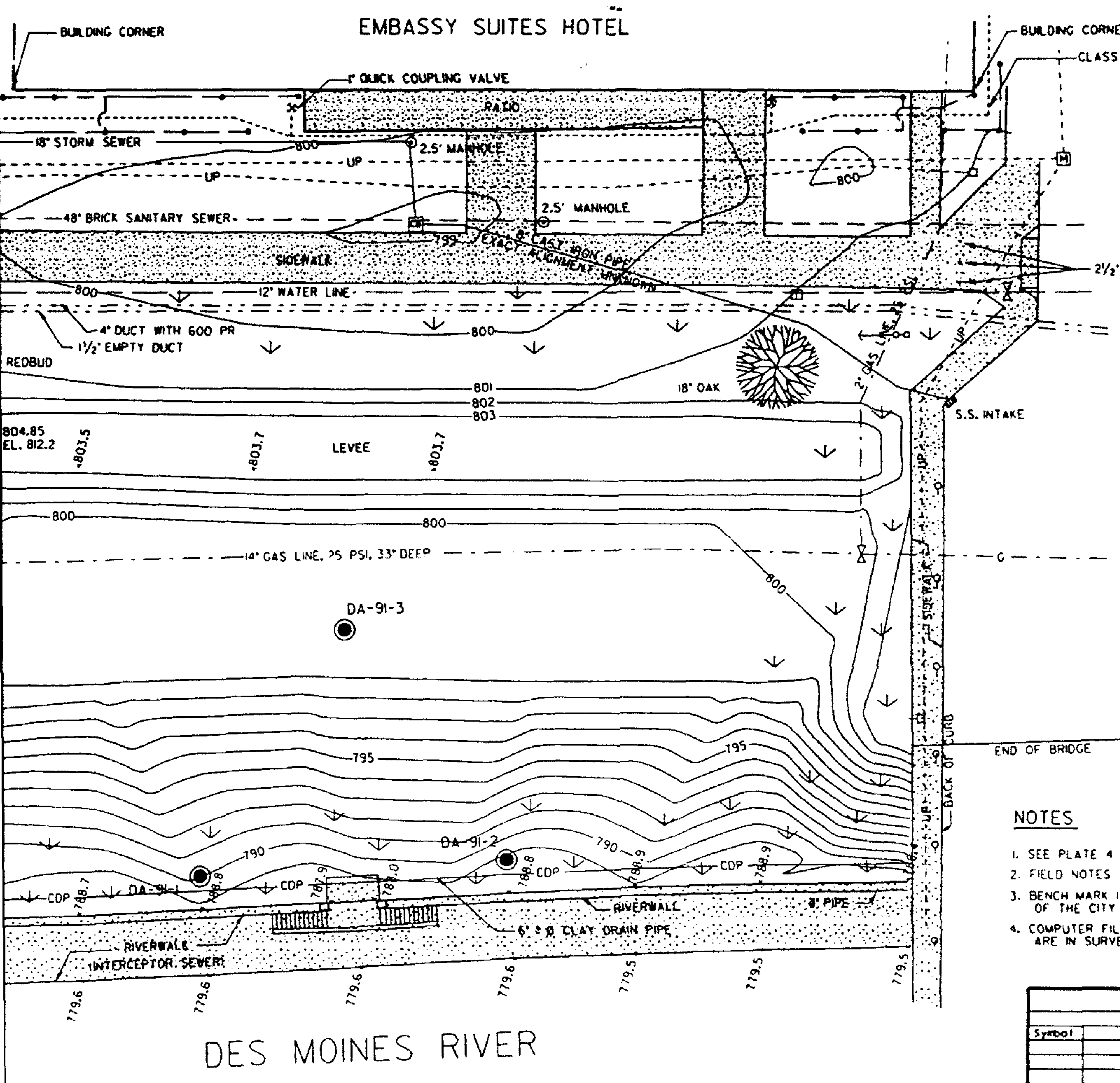


NOTES

1. SEE PLATE 4 FOR BORING LC
2. FIELD NOTES ARE IN BOOK F
3. BENCH MARK IS A TRIANGLE OF THE CITY HALL BUILDING.
4. COMPUTER FILES FOR THE OF ARE IN SURVEY BRANCH (FIL

LEGEND

—CDP—	CLAY DRAIN PIPE	○	POWER POLE
	TELECOMMUNICATIONS DUCT	M	ELECTRIC MANHOLE
	NATURAL GAS LINE	◎	MANHOLE
	WATER LINE	CB	CATCH BASIN
	UNDERGROUND POWER LINE	T	TELEPHONE BOX
	1" P.V.C. MAIN PIPE	•	4" SPRINKLER HEADS
	1" P.E. LATERAL PIPE		1" QUICK COUPLING VALVE
	LIGHT POLE		VALVE
	FIRE HYDRANT		CRASS
	PARKING METER	●	SOIL BORING LOCATION

GENERAL SITE PLAN

16 12 8 4 0 16 32FT

SCALE: 1/16"=1'-0"

213

Symbol	De

Designed by: ...

Drawn by: ...

Checked by: ...

Reviewed by: ...

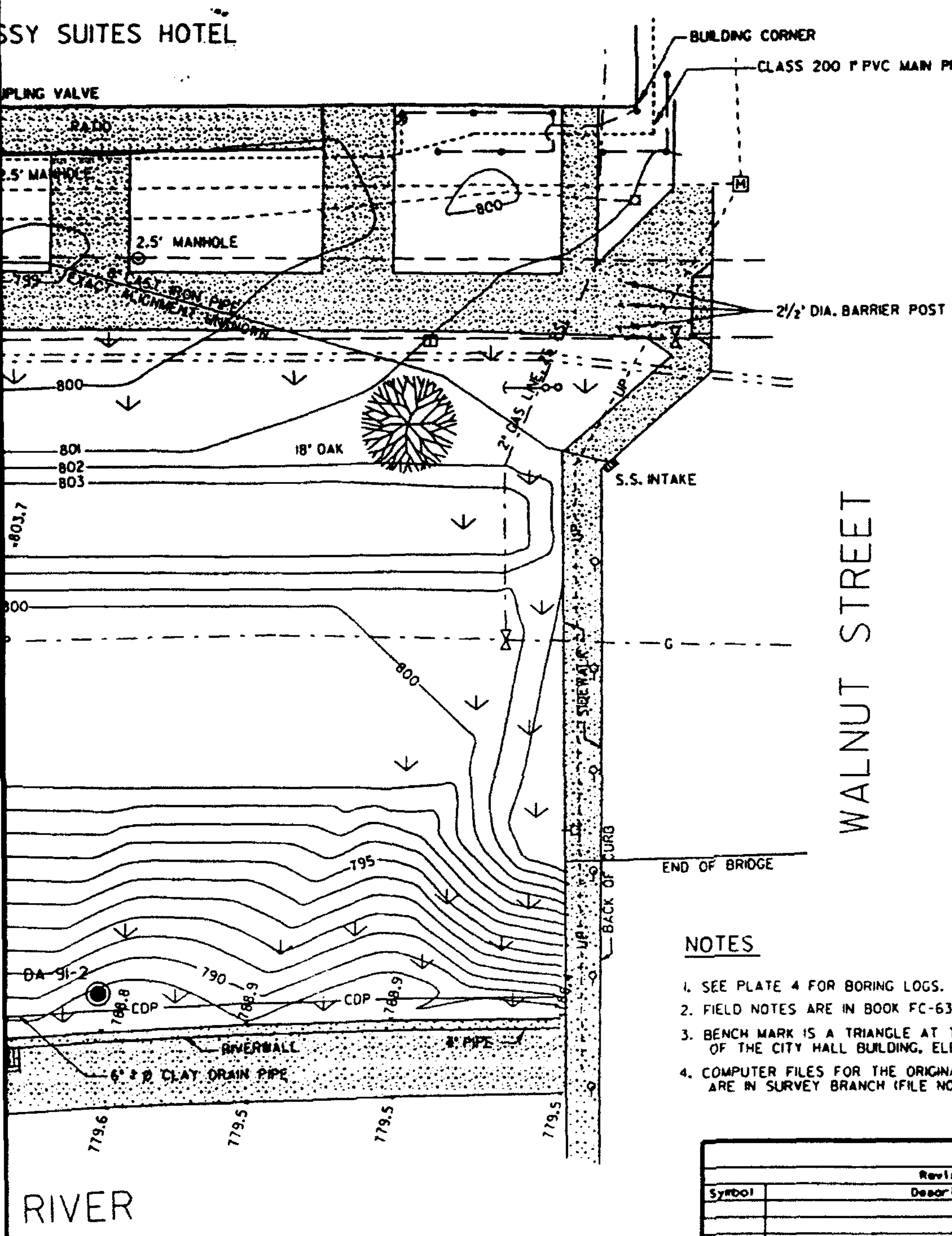
Approved by: JOHN R. BROWN COL., CORPS OF ENGINEERS

Scale: AS

Date:

Drawing Code:

	3	2



NOTES

1. SEE PLATE 4 FOR BORING LOGS.
2. FIELD NOTES ARE IN BOOK FC-63-35, PAGE 74.
3. BENCH MARK IS A TRIANGLE AT THE NORTHEAST CORNER OF THE CITY HALL BUILDING, ELEV. 802.77, NGVD 1929.
4. COMPUTER FILES FOR THE ORIGINAL FIELD INFORMATION ARE IN SURVEY BRANCH (FILE NO. DESPRK AND RELATED FILES).

LEGEND

—CDP—	CLAY DRAIN PIPE	O	POWER POLE
— - - —	TELECOMMUNICATIONS DUCT	M	ELECTRIC MANHOLE
— - - ·	NATURAL GAS LINE	⊙	MANHOLE
—— ——	WATER LINE	CB	CATCH BASIN
- - - - - -	UNDERGROUND POWER LINE	T	TELEPHONE BOX
·········	1" P.V.C. MAIN PIPE	•	4" SPRINKLER HEADS
— ——	1" P.E. LATERAL PIPE		1" QUICK COUPLING VALVE
	LIGHT POLE	⋈	VALVE
	FIRE HYDRANT		GRASS
	PARKING METER	◉	SOIL BORING LOCATION

343

Revisions			
Symbol	Description	Date	Approved

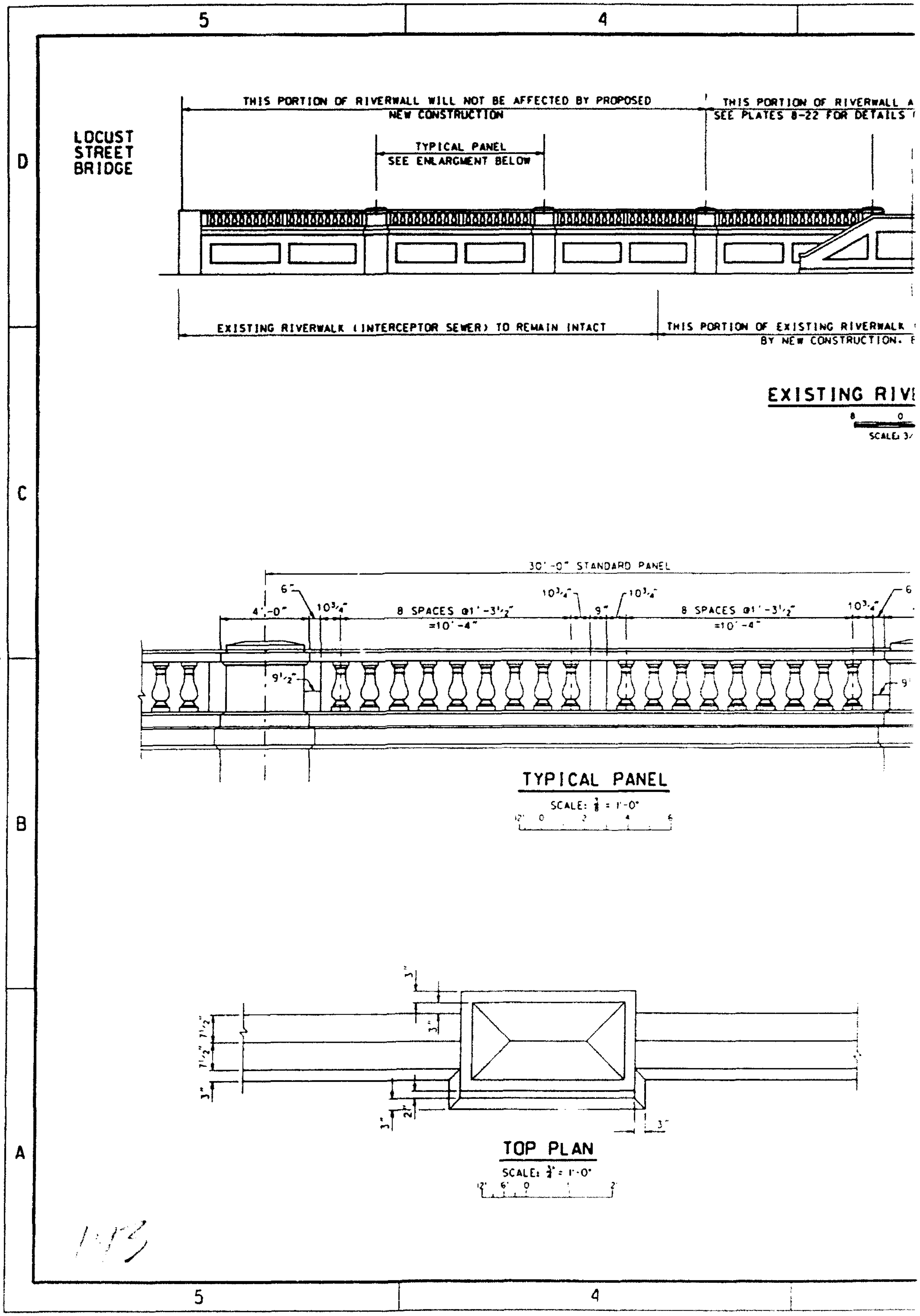
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: ...
Drawn by: ...
Checked by: ...
Reviewed by: ...
Approved by: JOHN R. BROWN COL., CORPS OF ENGINEERS

DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

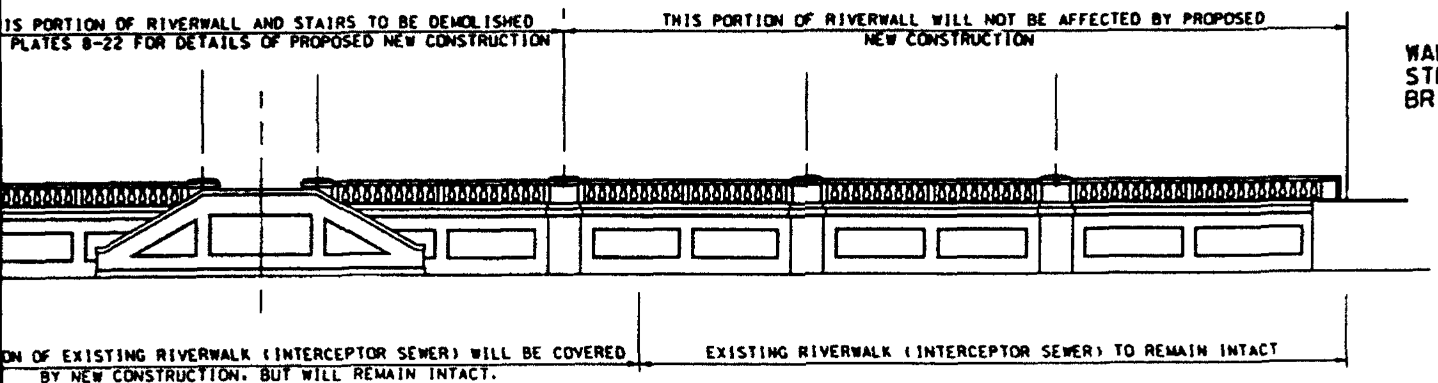
GENERAL SITE PLAN
(EXISTING CONDITIONS)

Scale: AS SHOWN
Date:
Drawing Code:
Sheet reference number: C-5
Solicitation Number: DACW25-9 -B-
Sheet of



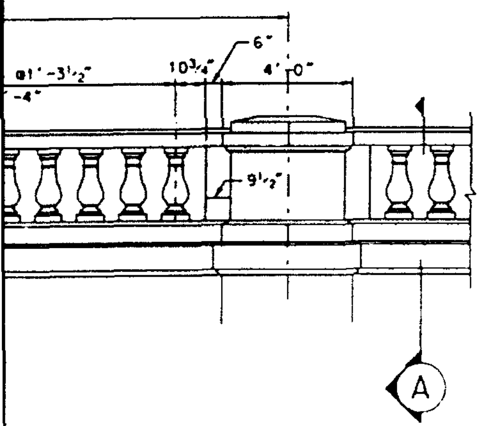
5
4
D
C
B
A
LOCUST STREET BRIDGE
THIS PORTION OF RIVERWALL WILL NOT BE AFFECTED BY PROPOSED NEW CONSTRUCTION
THIS PORTION OF RIVERWALL A
SEE PLATES 8-22 FOR DETAILS
TYPICAL PANEL
SEE ENLARGMENT BELOW
EXISTING RIVERWALK (INTERCEPTOR SEWER) TO REMAIN INTACT
THIS PORTION OF EXISTING RIVERWALK
BY NEW CONSTRUCTION.
EXISTING RIVI
30'-0" STANDARD PANEL
4'-0"
6"
10¾"
8 SPACES @1'-3½"
=10'-4"
9"
9½"
TYPICAL PANEL
SCALE: ⅜" = 1'-0"
TOP PLAN
SCALE: ½" = 1'-0"
3"
1½"
2"

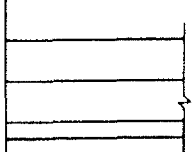
3 | 2 | 1

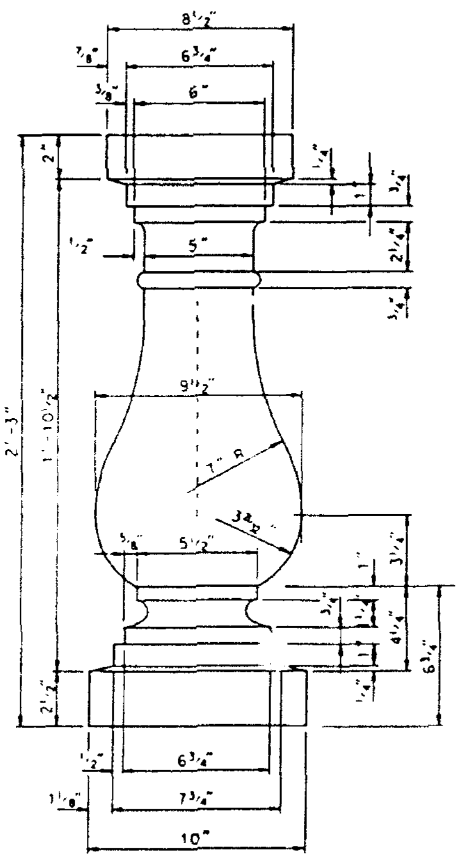


EXISTING RIVERWALL ELEVATION

8 0 8 16FT
SCALE: 3/32" = 1'-0"

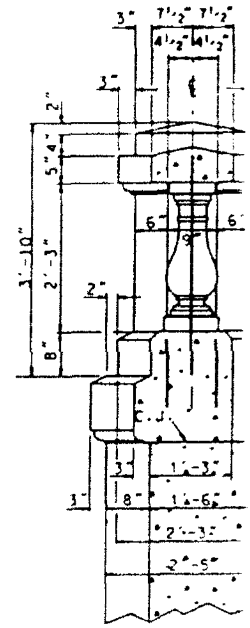






DETAIL OF BALUSTER

SCALE: 3" = 1'-0"
0 3" 6" 12"



SECTION A

SCALE: ¾" = 1'-0"

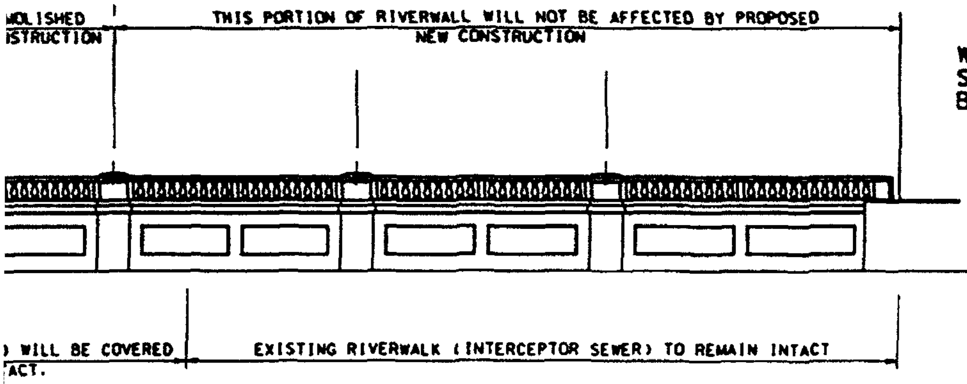
Revisions	
Symbol	Description

U.S. ARM... CORP... ROCK...

Designed by: ...	US Army Corps of Engineers	DES MOINES RECREA... DOWNTOW... PLAZA/...
Drawn by: ...		
Checked by: ...	ELEVATION A... OF EXISTING...	
Reviewed by: ...	Scale: AS SHOWN	Sheet reference number
Approved by: JOHN R. BROWN COL., CORPS OF ENGINEERS	Date: / Drawing Code:	C-...

3 | 2 | 1

9063



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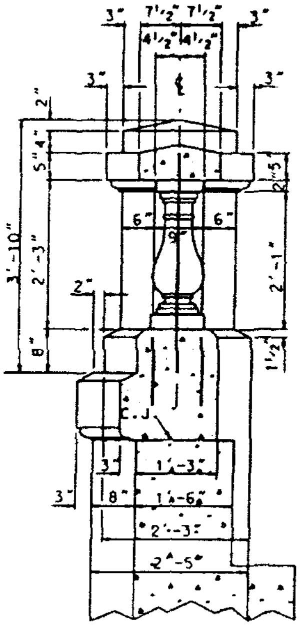
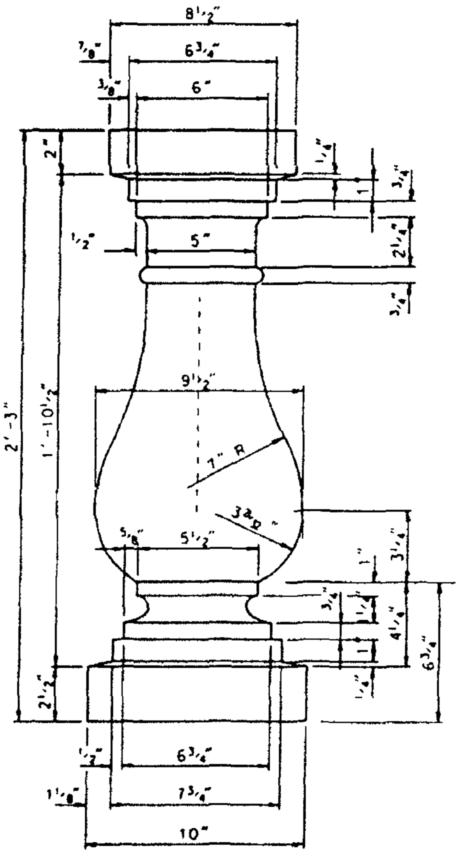


SECTION (A)

SCALE: ¾" = 1'-0"



DETAIL OF BALUSTER

SCALE: 3" = 1'-0"

3683

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: ...
Drawn by: ...
Checked by: ...
Reviewed by: ...
Approved by: JOHN R. BROWN COL., CORPS OF ENGINEERS

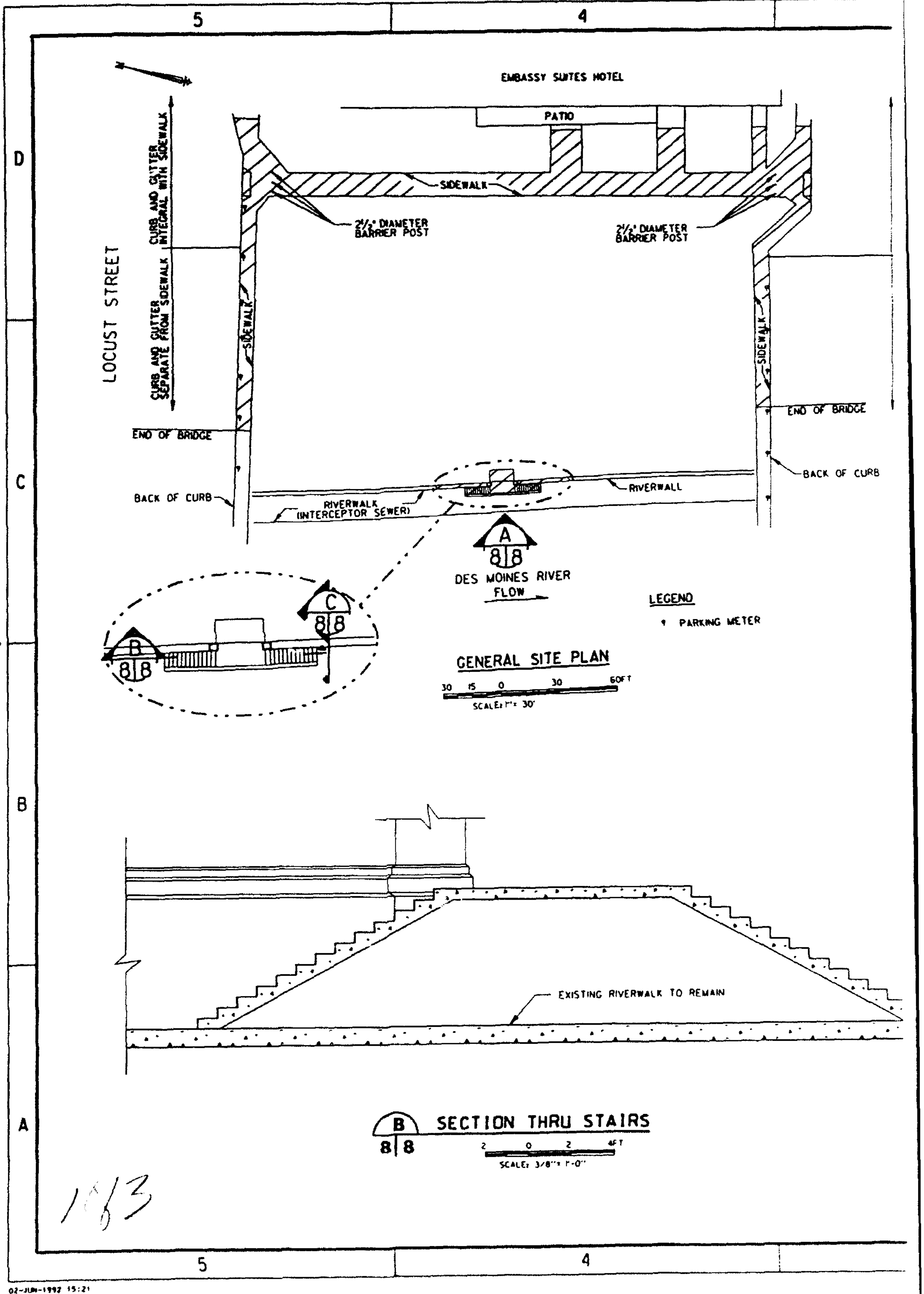
US Army Corps of Engineers

DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

ELEVATION AND DETAILS OF EXISTING RIVERWALL

Scale: AS SHOWN
Date:
Drawing Code:
Sheet reference number: C-6
Solicitation Number: DACW25-9 -B-
Sheet of

PLATE 7



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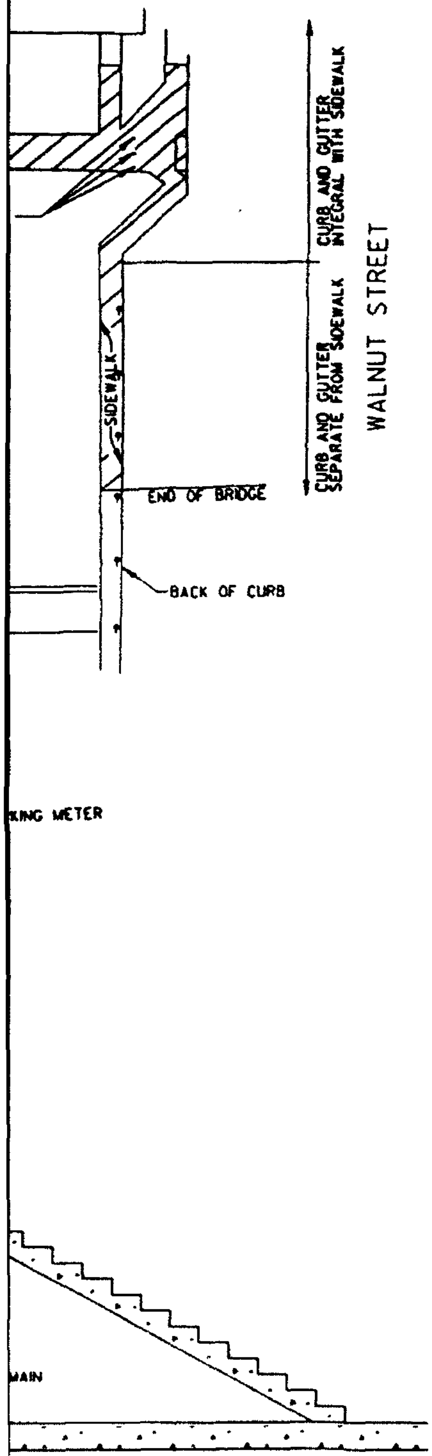
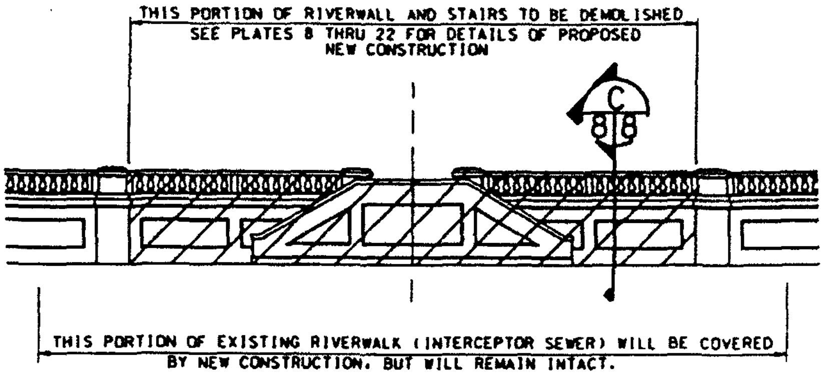
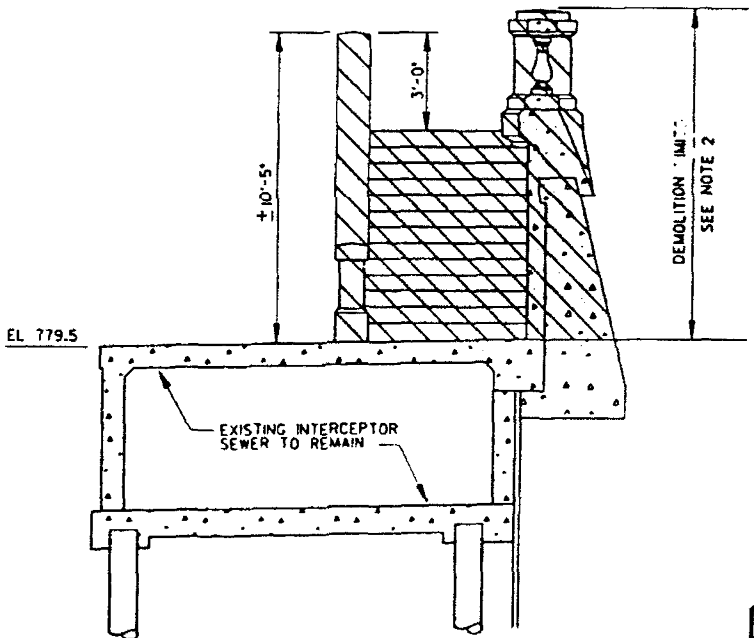




A 8|8 EXISTING RIVERWALL ELEVATION

8 0 8 16FT
SCALE: 3/32"= 1'-0"



C 8|8 SECTION THRU SEWER

2 0 2 4FT
SCALE: 3/8"= 1'-0"

NOTES

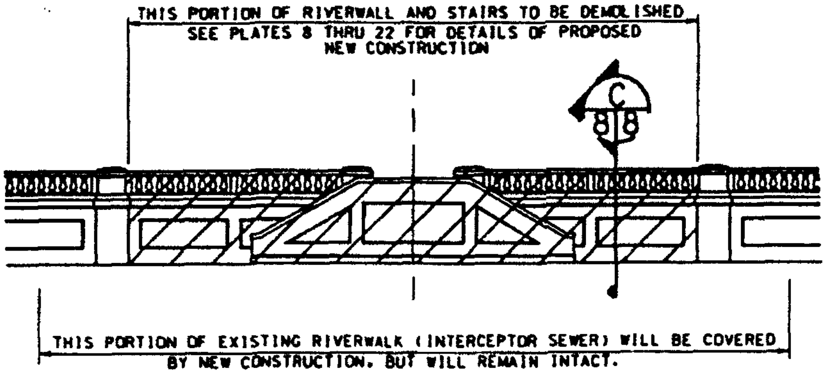
1. REMOVED PARKING METERS AND BARRIER POSTS TO BE SALVAGED AND TRANSFERRED TO CITY OF DES MOINES.
2. DEMOLITION AND REMOVAL OF EXISTING RIVERWALL STRUCTURE MAY BE LIMITED TO THAT WHICH IS REQUIRED TO ACCOMMODATE NEW CONSTRUCTION. SEE PLATES 16 AND 19 ALSO.

263

Revisions	
Symbol	Description

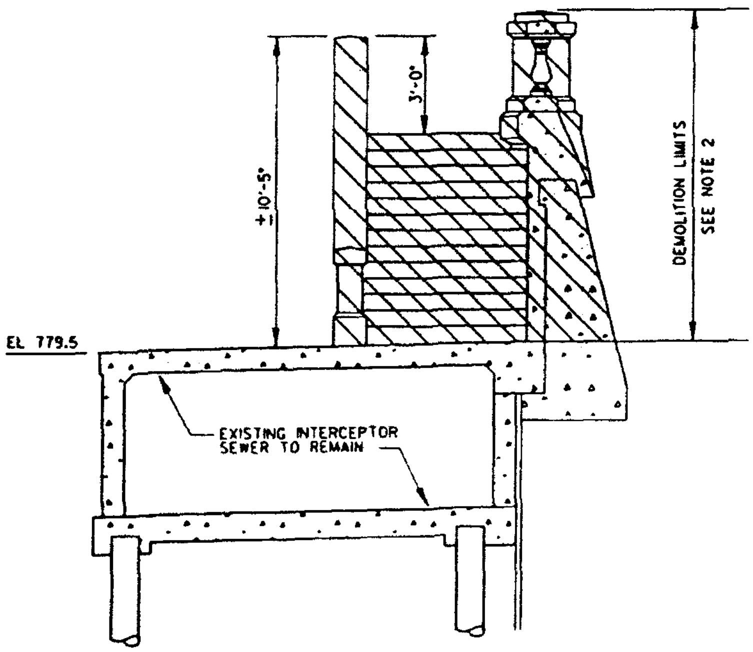
U.S. A
C
ROC

Designed by: ...	US Army Corps of Engineers — DES MOINES RE DOWN PLAZ
Drawn by: ...	
Checked by: ...	DEMOLITION PL
Reviewed by: ...	Scale: AS SHOWN
	Date:
Approved by: JOHN R. BROWN COL., CORPS OF ENGINEERS	Drawing Code:



A 8|8 EXISTING RIVERWALL ELEVATION

SCALE: 3/32" = 1'-0"



C 8|8 SECTION THRU SEWER

SCALE: 3/8" = 1'-0"

NOTES

1. REMOVED PARKING METERS AND BARRIER POSTS TO BE SALVAGED AND TRANSFERRED TO CITY OF DES MOINES.
2. DEMOLITION AND REMOVAL OF EXISTING RIVERWALL STRUCTURE MAY BE LIMITED TO THAT WHICH IS REQUIRED TO ACCOMMODATE NEW CONSTRUCTION. SEE PLATES 16 AND 19 ALSO.

3/13

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

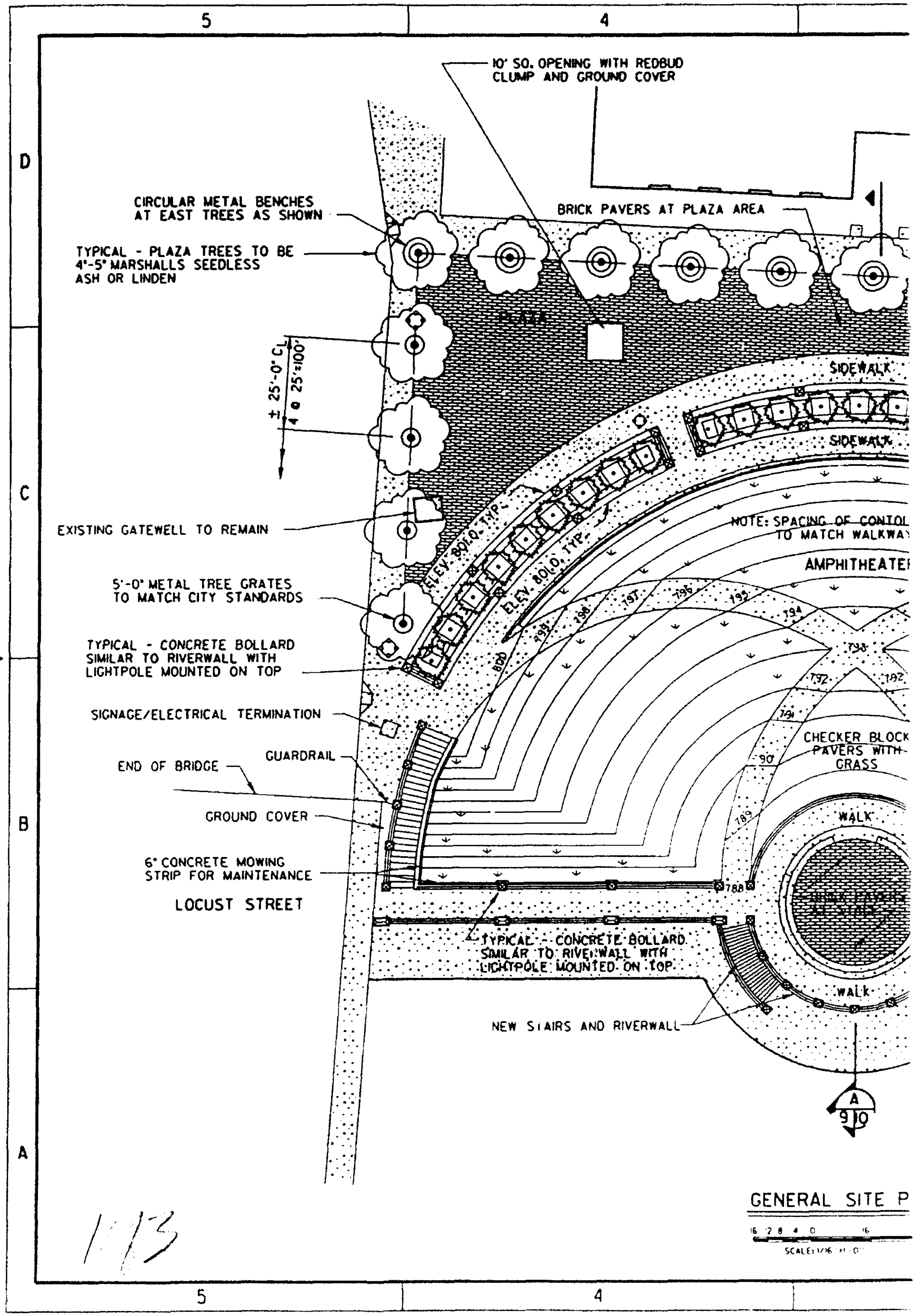
DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

DEMOLITION PLAN AND DETAILS

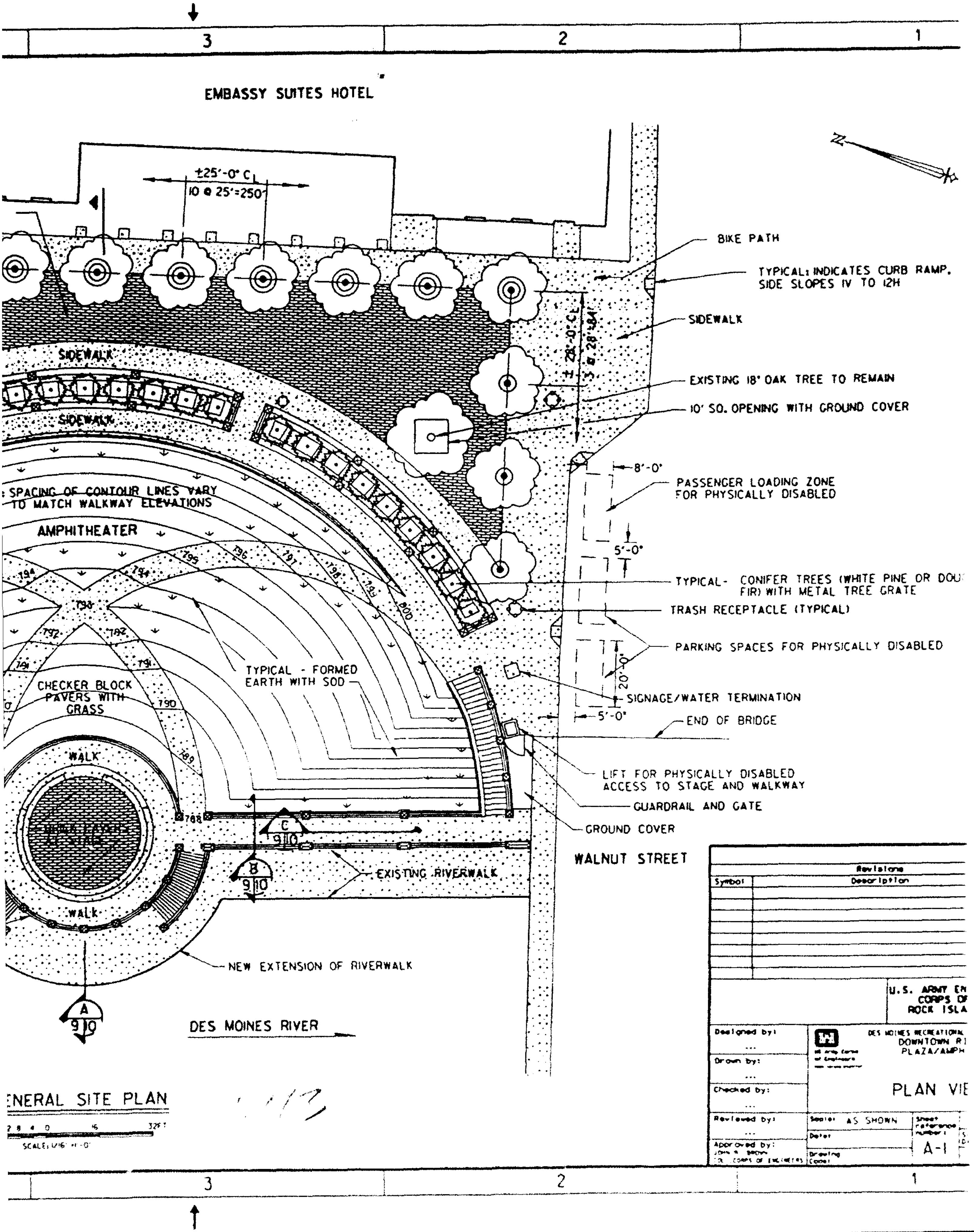
Designed by: ...
Drawn by: ...
Checked by: ...
Reviewed by: ...
Approved by: JOHN R. BROWN, COL., CORPS OF ENGINEERS

Scale: AS SHOWN
Date:
Drawing Code:
Sheet reference number: C-7
Solicitation Number: DACW25-9 -B-
Sheet of

PLATE 8



02-JUN-1992 15:15



3
2
1
EMBASSY SUITES HOTEL
±25'-0" C L
10 @ 25'=250'
BIKE PATH
TYPICAL: INDICATES CURB RAMP, SIDE SLOPES 1V TO 12H
SIDEWALK
± 28'-0" C L
3 @ 28'=84'
EXISTING 18" OAK TREE TO REMAIN
10' SQ. OPENING WITH GROUND COVER
8'-0"
PASSENGER LOADING ZONE FOR PHYSICALLY DISABLED
5'-0"
TYPICAL - CONIFER TREES (WHITE PINE OR DOU FIR) WITH METAL TREE GRATE
TRASH RECEPTACLE (TYPICAL)
PARKING SPACES FOR PHYSICALLY DISABLED
20'-0"
SIGNAGE/WATER TERMINATION
5'-0"
END OF BRIDGE
LIFT FOR PHYSICALLY DISABLED ACCESS TO STAGE AND WALKWAY
GUARDRAIL AND GATE
GROUND COVER
WALNUT STREET
SIDEWALK
SIDEWALK
SPACING OF CONTOUR LINES VARY TO MATCH WALKWAY ELEVATIONS
AMPHITHEATER
799
796
797
798
799
800
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792
792
791
791
790
789
788
TYPICAL - FORMED EARTH WITH SOD
CHECKER BLOCK PAVERS WITH GRASS
WALK
WALK
C
9 10
B
9 10
EXISTING RIVERWALK
NEW EXTENSION OF RIVERWALK
A
9 10
DES MOINES RIVER
ENERAL SITE PLAN
SCALE: 1/16" = 1'-0"
Revisions
Symbol
Description
U.S. ARMY EN CORPS OF ROCK ISLA
Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by:
DES MOINES RECREATIONAL DOWNTOWN RI PLAZA/AMPH
PLAN VIE
Scale: AS SHOWN
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Drawing Code:
Sheet reference number:
A-1
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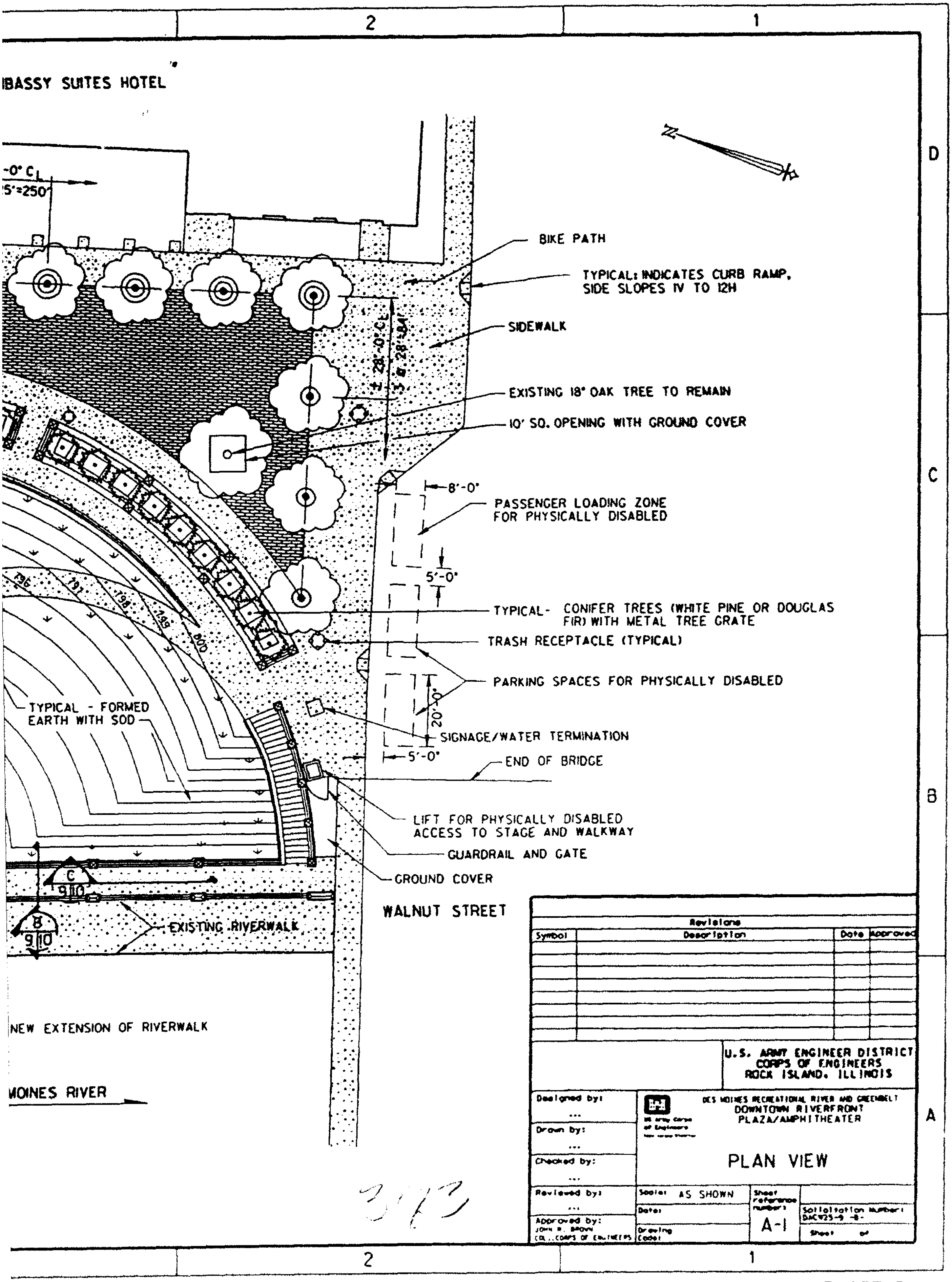
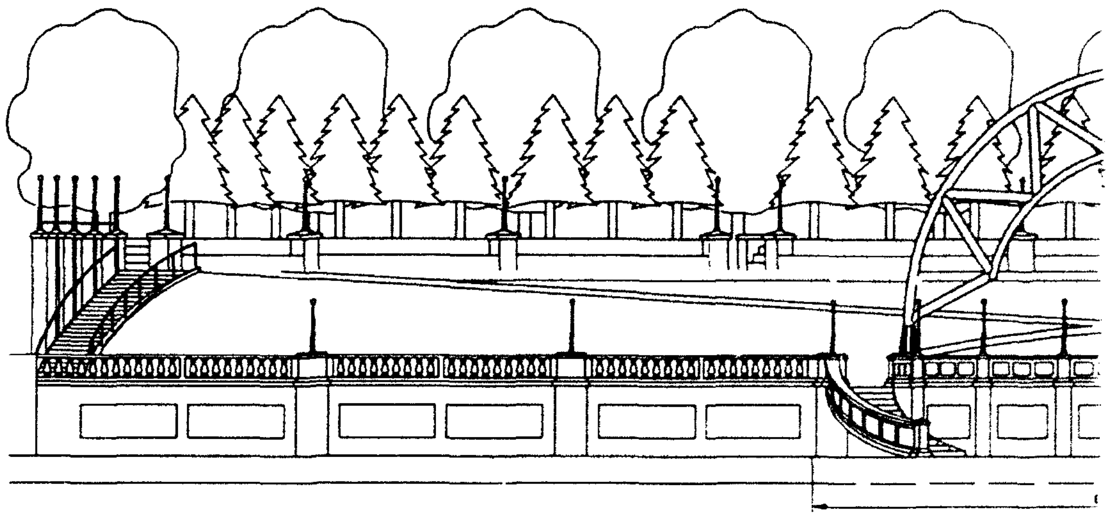


BASSY SUITES HOTEL
BIKE PATH
TYPICAL: INDICATES CURB RAMP, SIDE SLOPES 1V TO 12H
SIDEWALK
EXISTING 18" OAK TREE TO REMAIN
10' SQ. OPENING WITH GROUND COVER
8'-0"
PASSENGER LOADING ZONE FOR PHYSICALLY DISABLED
5'-0"
TYPICAL- CONIFER TREES (WHITE PINE OR DOUGLAS FIR) WITH METAL TREE GRATE
TRASH RECEPTACLE (TYPICAL)
PARKING SPACES FOR PHYSICALLY DISABLED
20'-0"
SIGNAGE/WATER TERMINATION
5'-0"
END OF BRIDGE
TYPICAL - FORMED EARTH WITH SOD
LIFT FOR PHYSICALLY DISABLED ACCESS TO STAGE AND WALKWAY
GUARDRAIL AND GATE
GROUND COVER
WALNUT STREET
EXISTING RIVERWALK
NEW EXTENSION OF RIVERWALK
MOINES RIVER
Revisions
Symbol
Description
Date
Approved
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS
Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by:
DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER
PLAN VIEW
Scale: AS SHOWN
Date:
Drawing Code:
Sheet reference number:
A-1
Solicitation Number: DACW25-9 -B-
Sheet of

PLATE 9

5 4

D



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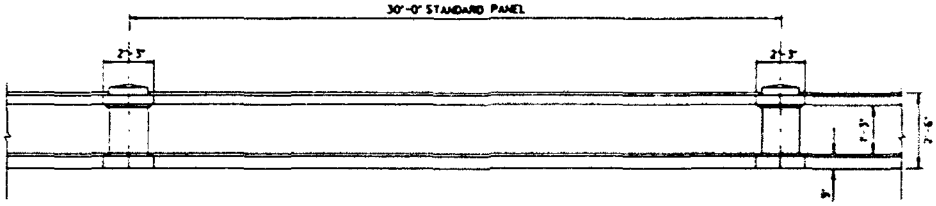
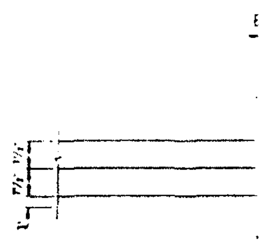


C
9|10 BENCH WALL TYPICAL PANEL

SCALE: 1/2" = 1'-0"



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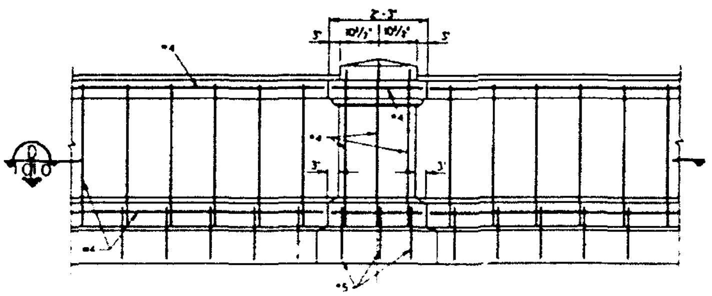
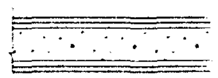
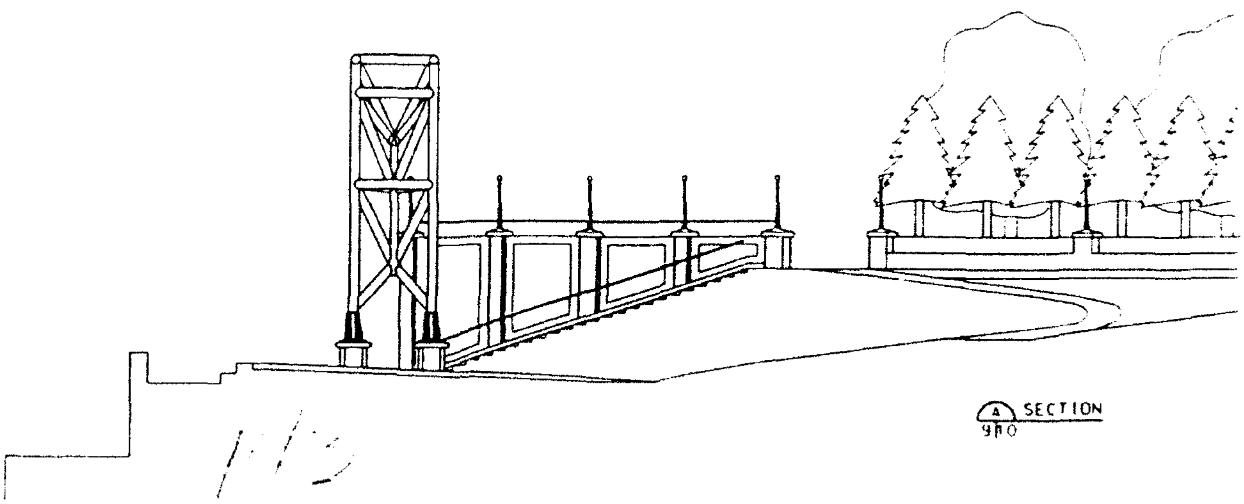




SCALE: 1/2" = 1'-0"

BENCH WALL SIDE ELEVATION

A



A
9|10 SECTION

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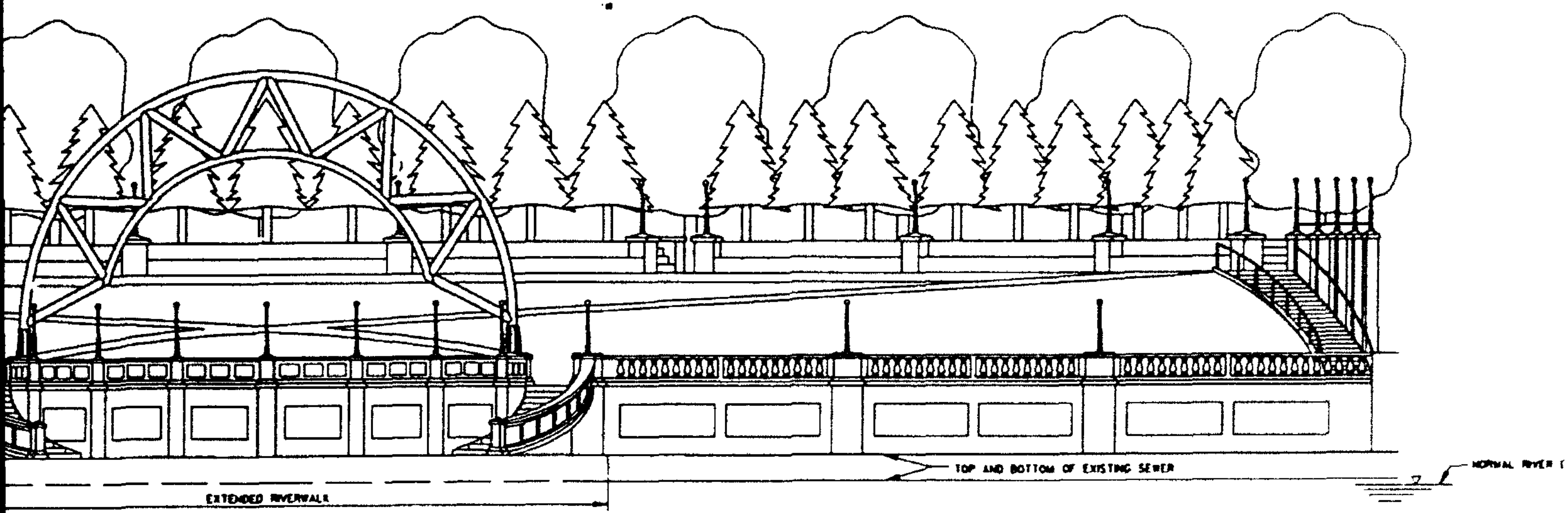
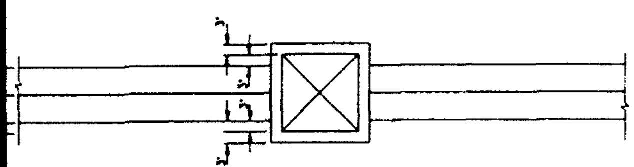


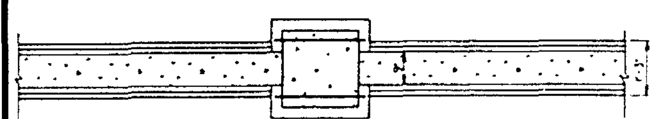
ELEVATION

SCALE: 1"= 10'



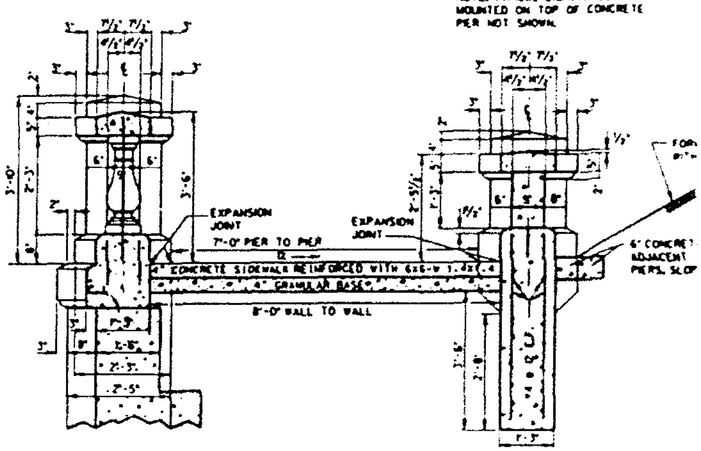
TOP PLAN

SCALE: 1/2" = 1'-0"



D SECTION
10|10

SCALE: 1/2" = 1'-0"

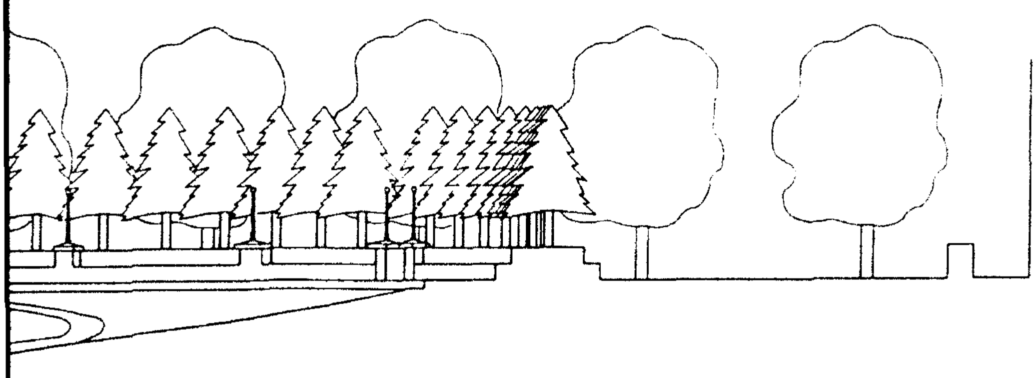


EXISTING RIVERWALL

NEW WALL

SCALE: 1/2" = 1'-0"

B SECTION
9|10



SECTION

SCALE: 1"= 10'

4/3

Revisions	
Symbol	Description

U.S. ARMY ENGI
CORPS OF E
ROCK ISLAND

Designed by: ...
Drawn by: ...
Checked by: ...
Reviewed by: ...
Approved by: JOHN R. BROWN COL., CORPS OF ENGINEERS

DES MOINES RECREATIONAL RIV
DOWNTOWN RIVE
PLAZA/AMPHIT

ELEVATION & SEC

Scale: AS SHOWN
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Drawing Code:
Sheet reference number: A-2

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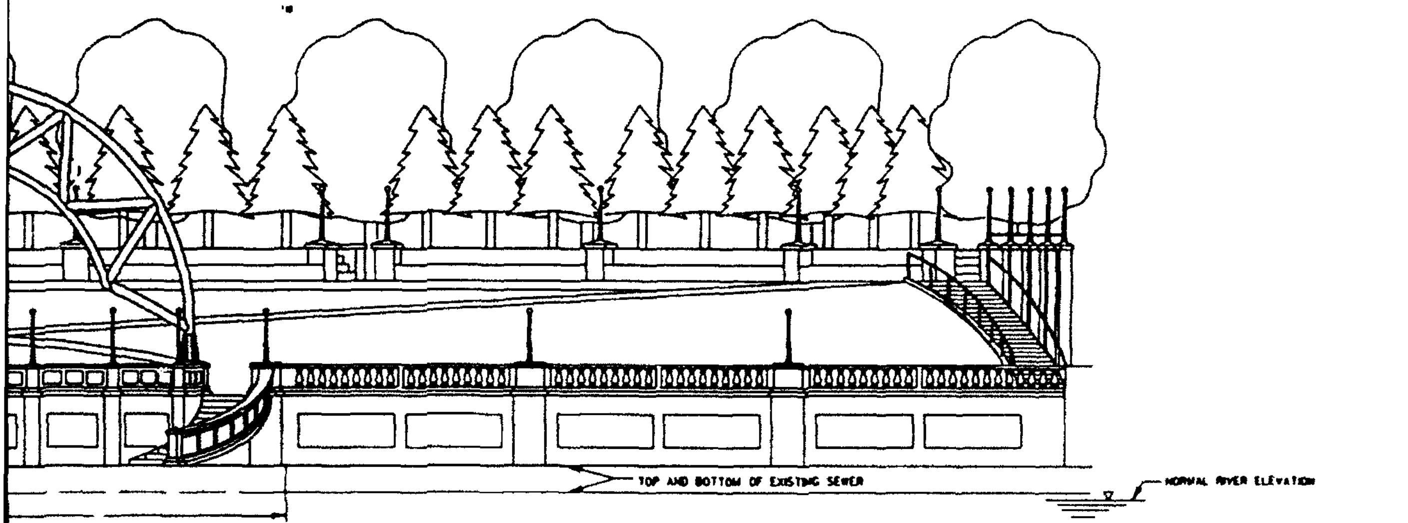
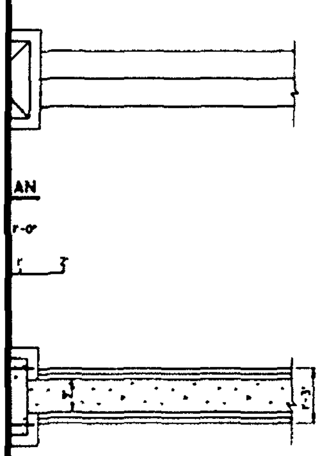
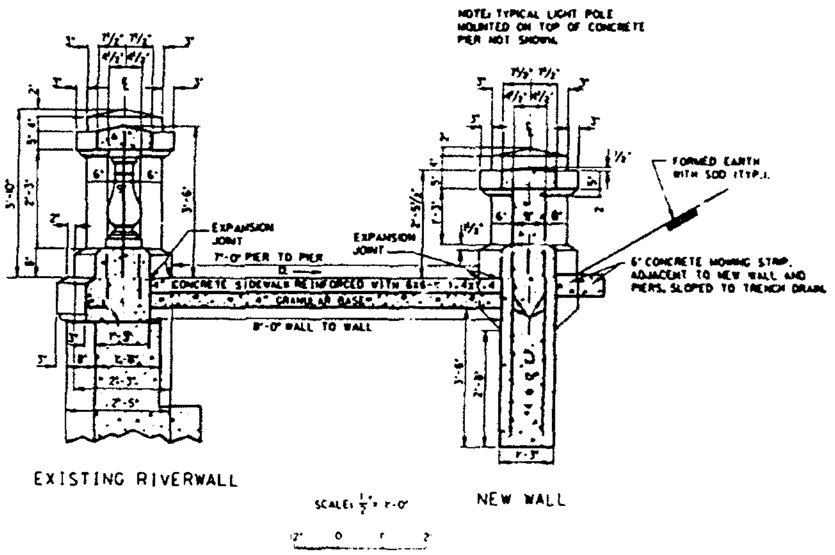
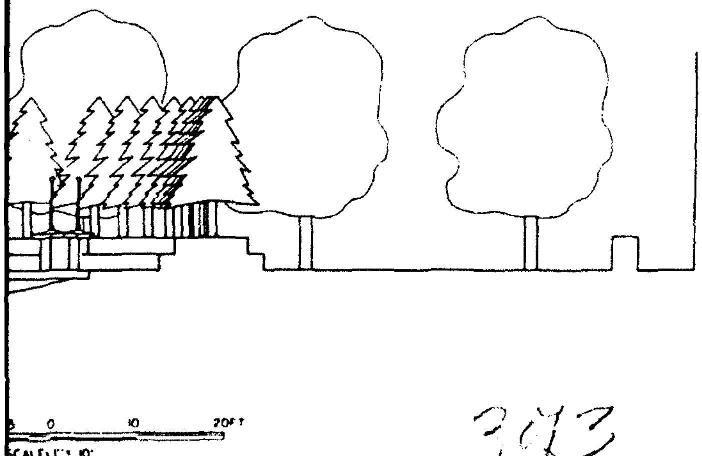






B SECTION 9/10



343

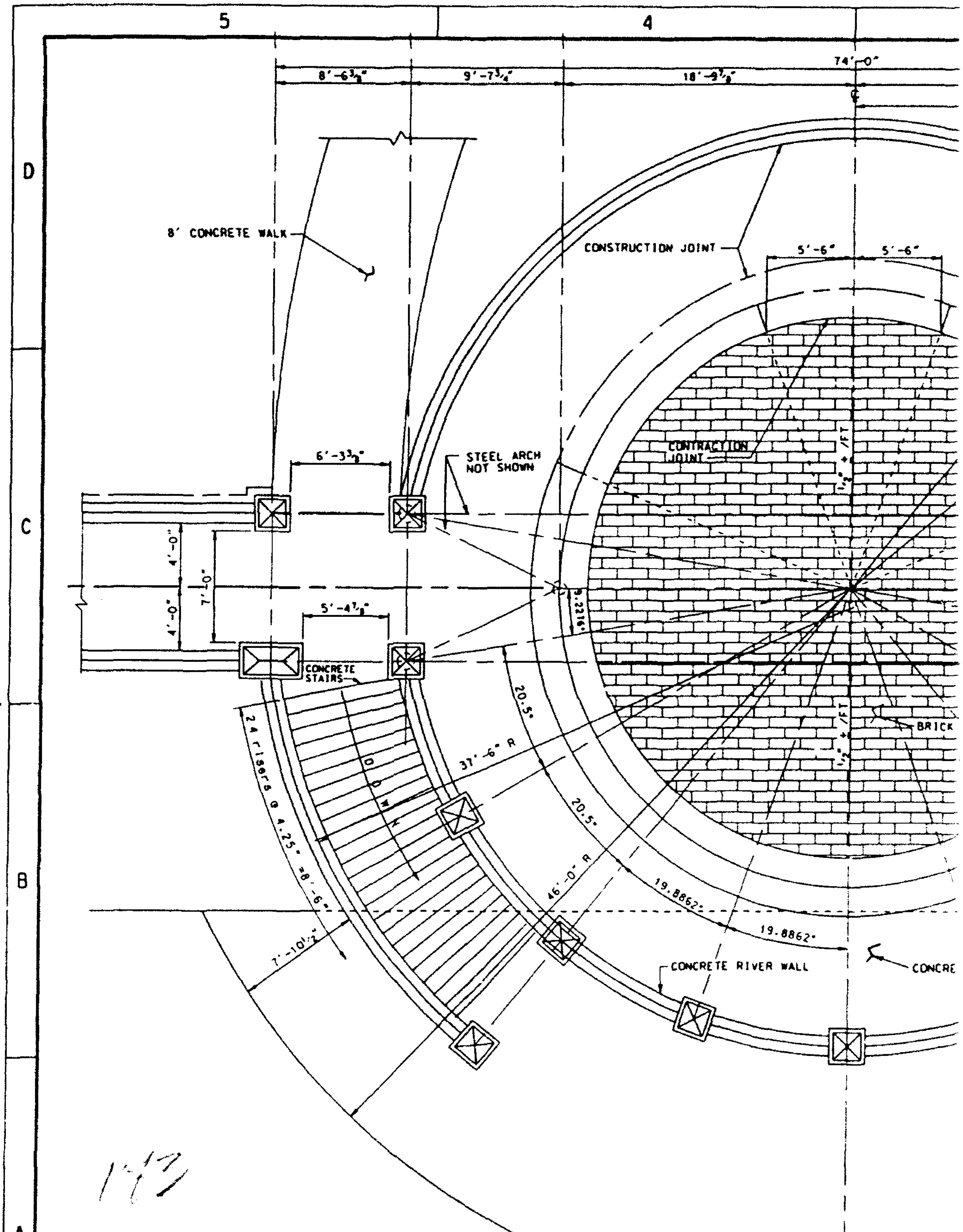
Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: ...	DES MOINES RECREATIONAL RIVER AND GREENBELT DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER
Drawn by: ...	
Checked by: ...	ELEVATION & SECTIONS
Reviewed by: ...	Scale: AS SHOWN · Sheet reference number: A-2
Approved by: JOHN R. BROWN, COL., CORPS OF ENGINEERS	Date: · Drawing Code: · Solicitation Number: DACW25-9 -B- · Sheet of

2 | 1

PLATE 10

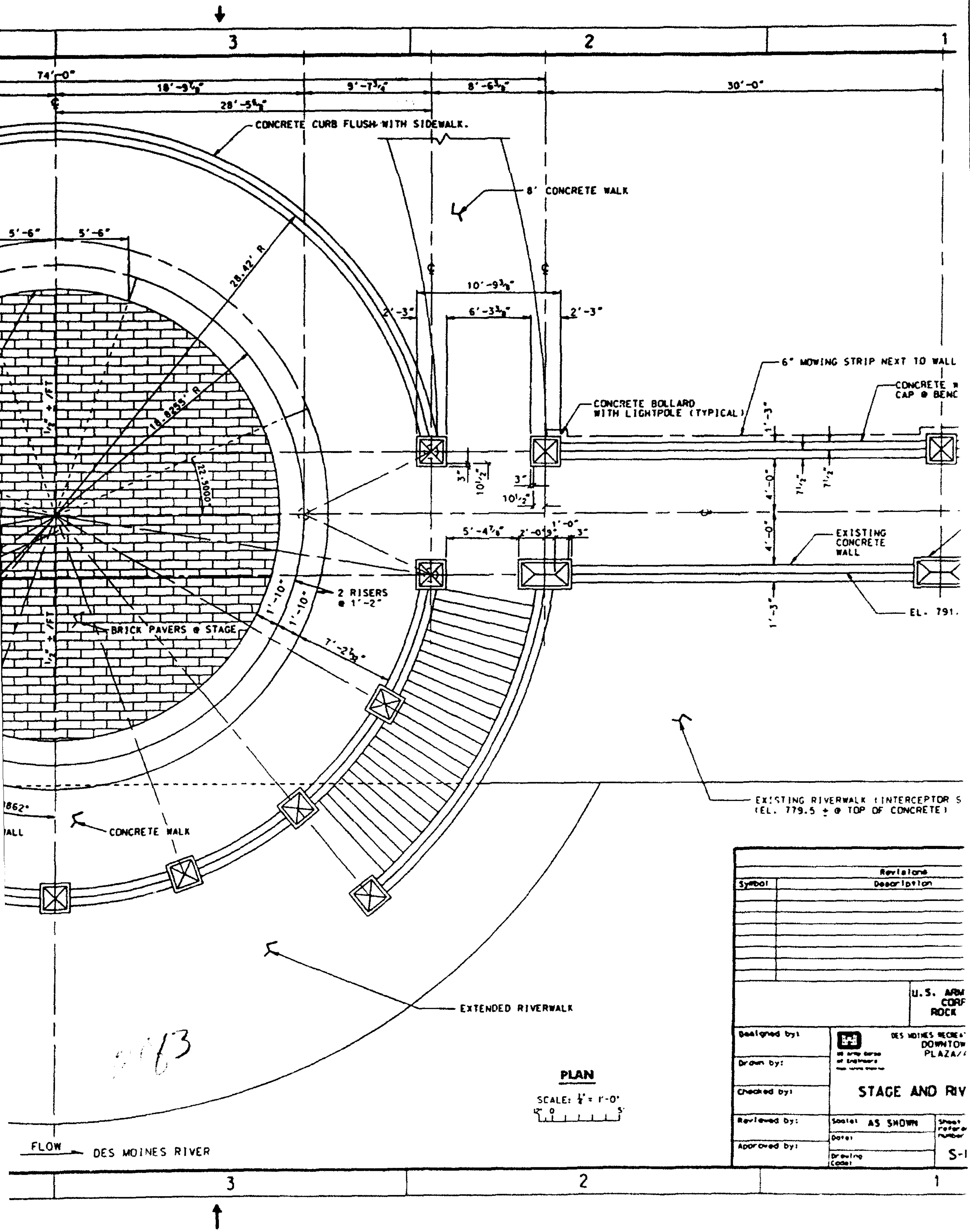


GENERAL NOTES:

1. NEW RIVERWALL @ STAIR & STAGE TO MATCH EXISTING MATERIAL & FINISH. FREQUENCY OF PANELS AND NO. OF PILASTERS ARE DOUBLED WITH SOLID PANELIZED GUARDRAILS.

2. NO FILL WILL BE PLACED IN THE DES MOINES RIVER.

02-JUN-1992 15:22
/s:g1/gb04/gb04a004.dgn


CONCRETE CURB FLUSH WITH SIDEWALK.
8' CONCRETE WALK
6" MOWING STRIP NEXT TO WALL
CONCRETE BOLLARD WITH LIGHTPOLE (TYPICAL)
EXISTING CONCRETE WALL
EL. 791.
2 RISERS @ 1'-2"
BRICK PAVERS @ STAGE
28.42' R
18.8255' R
22.5000°
CONCRETE WALK
EXISTING RIVERWALK (INTERCEPTOR S
(EL. 779.5 ± @ TOP OF CONCRETE)
EXTENDED RIVERWALK
FLOW
DES MOINES RIVER
PLAN
SCALE: 1/4" = 1'-0"
Revisions
Symbol
Description
U.S. ARM
CORP
ROCK
Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by:
DES MOINES RECREA
DOWNTOW
PLAZA/
STAGE AND RIV
Scale: AS SHOWN
Date:
Drawing Code:
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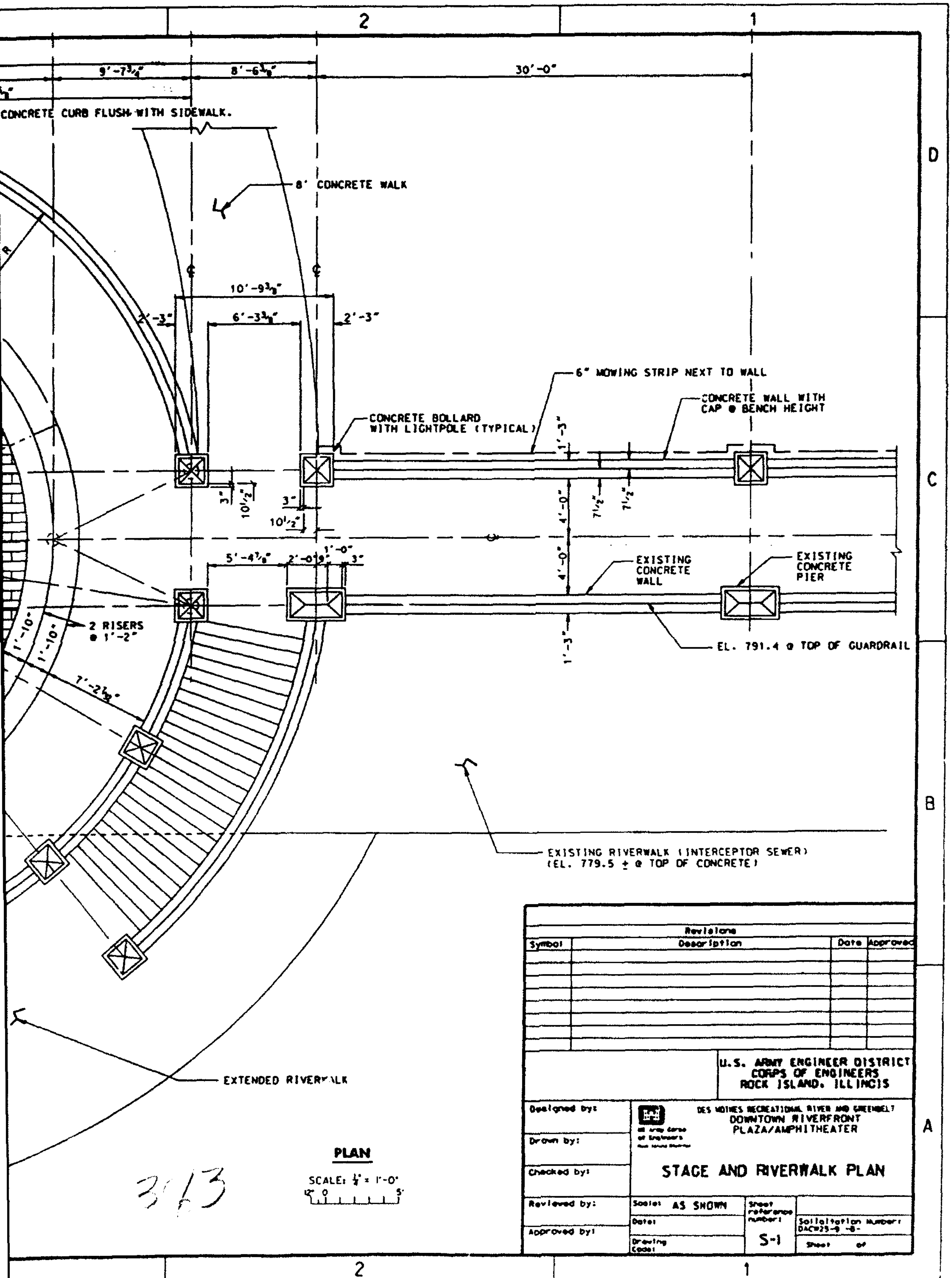
9'-7 3/4"
8'-6 1/8"
30'-0"
CONCRETE CURB FLUSH WITH SIDEWALK.
8' CONCRETE WALK
10'-9 3/8"
2'-3"
6'-3 3/8"
2'-3"
6" MOWING STRIP NEXT TO WALL
CONCRETE WALL WITH CAP @ BENCH HEIGHT
CONCRETE BOLLARD WITH LIGHTPOLE (TYPICAL)
1'-3"
3"
10 1/2"
3"
10 1/2"
4'-0"
7 1/2"
7 1/2"
5'-4 7/8"
2'-0"
9"
1'-0"
3"
4'-0"
EXISTING CONCRETE WALL
EXISTING CONCRETE PIER
2 RISERS @ 1'-2"
1'-10"
1'-10"
EL. 791.4 @ TOP OF GUARDRAIL
1'-3"
7'-2 3/8"
EXISTING RIVERWALK (INTERCEPTOR SEWER)
(EL. 779.5 ± @ TOP OF CONCRETE)
EXTENDED RIVERWALK
PLAN
SCALE: 1/4" = 1'-0"
3/13
Revisions
Symbol
Description
Date
Approved
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS
Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by:
DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER
STAGE AND RIVERWALK PLAN
Scale: AS SHOWN
Date:
Drawing Code:
Sheet reference number:
S-1
Solicitation Number: DACW25-9 -B-
Sheet of
2
1
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C
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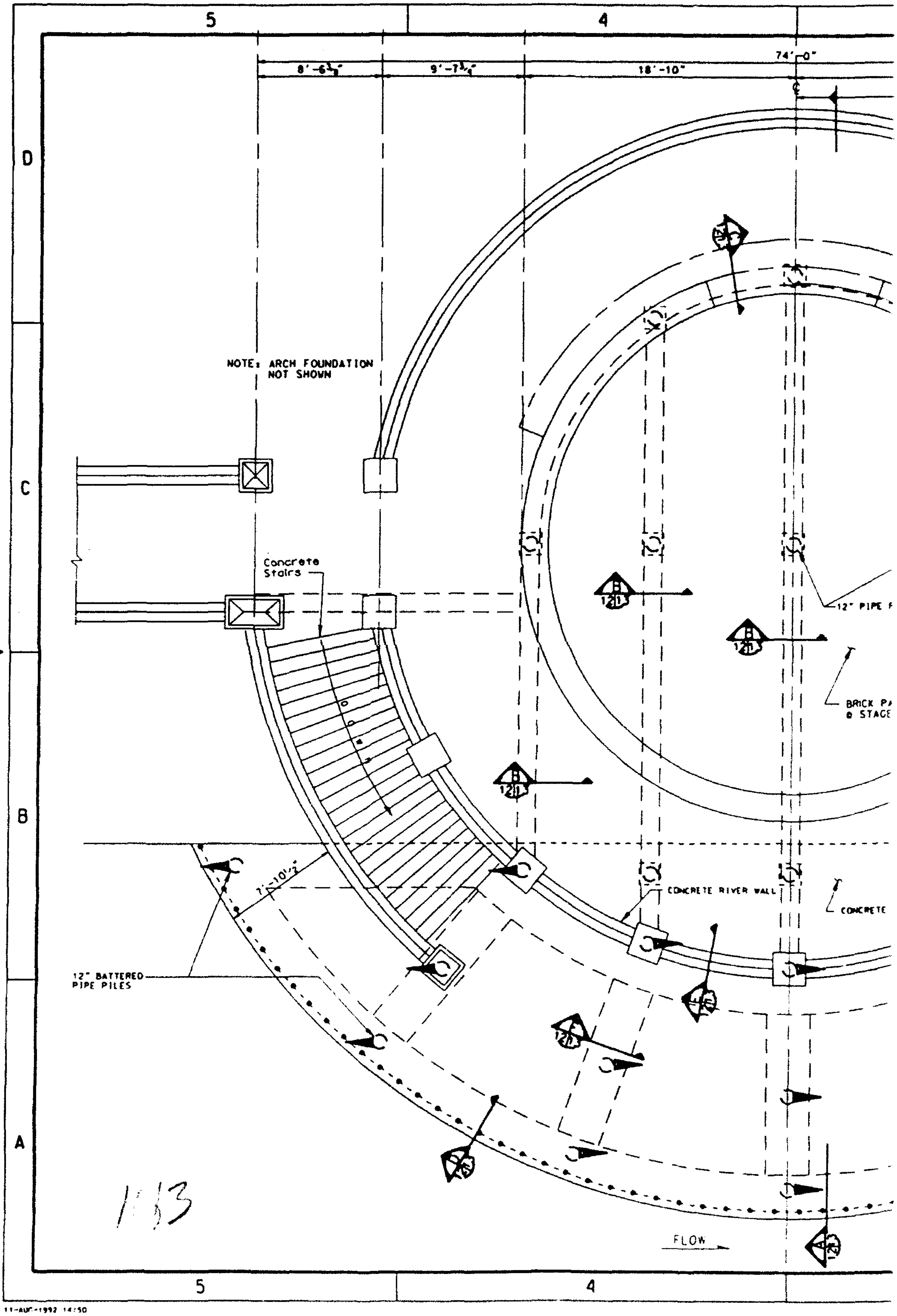
PLATE II



11-AUG-1992 14:50
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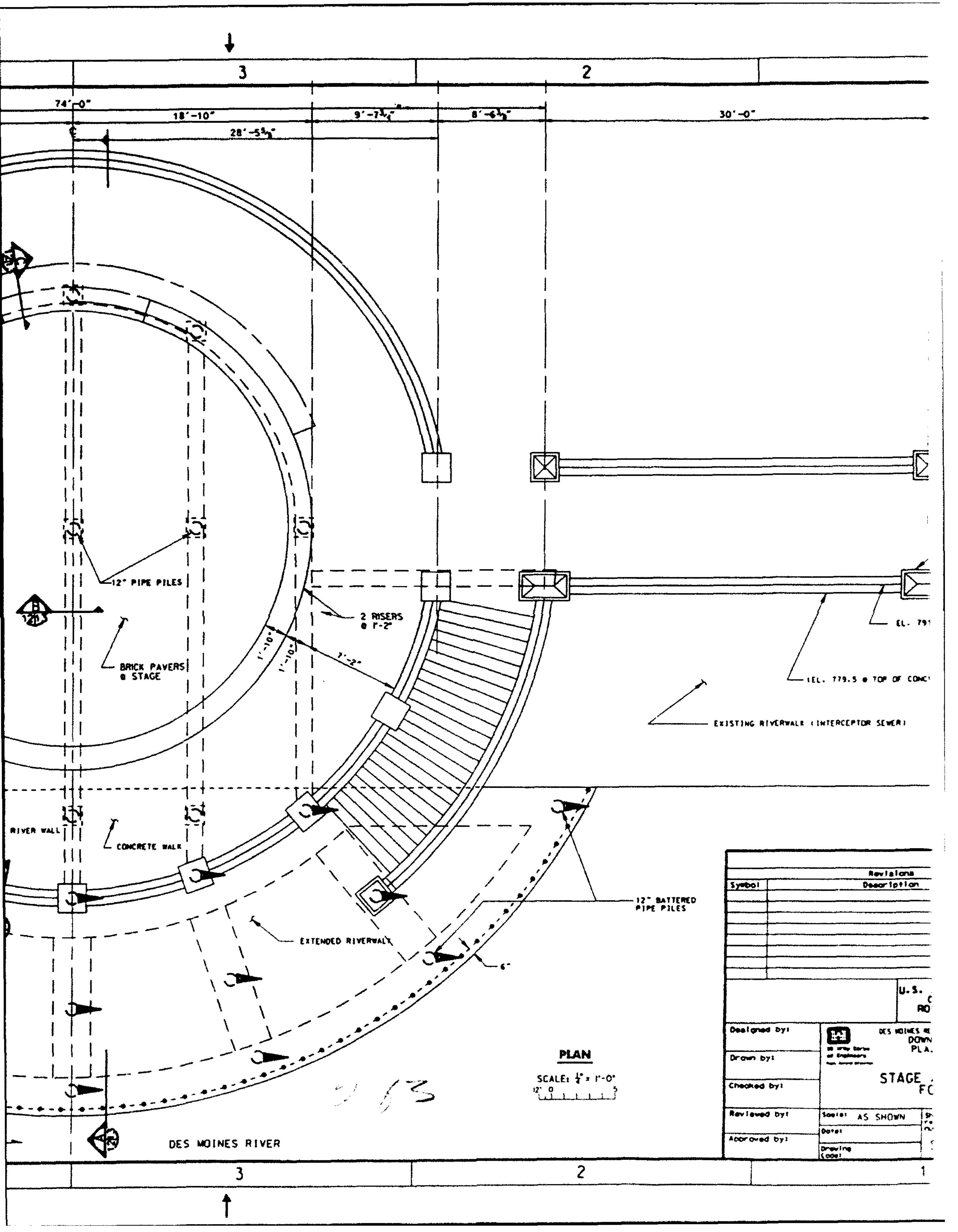

3
2
74'-0"
18'-10"
9'-7¾"
8'-6⅞"
30'-0"
28'-5⅝"
12" PIPE PILES
2 RISERS @ 1'-2"
1'-10"
1'-10"
7'-2"
BRICK PAVERS @ STAGE
EL. 779.5 @ TOP OF CONC
EXISTING RIVERWALK (INTERCEPTOR SEWER)
RIVER WALL
CONCRETE WALK
12" BATTERED PIPE PILES
EXTENDED RIVERWALK
6"
PLAN
SCALE: ¼" = 1'-0"
DES MOINES RIVER
Revisions
Symbol
Description
U.S.
Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by:
DES MOINES RI
DOWN
PLA
STAGE
FC
Scale: AS SHOWN
Date:
Drawing Code:
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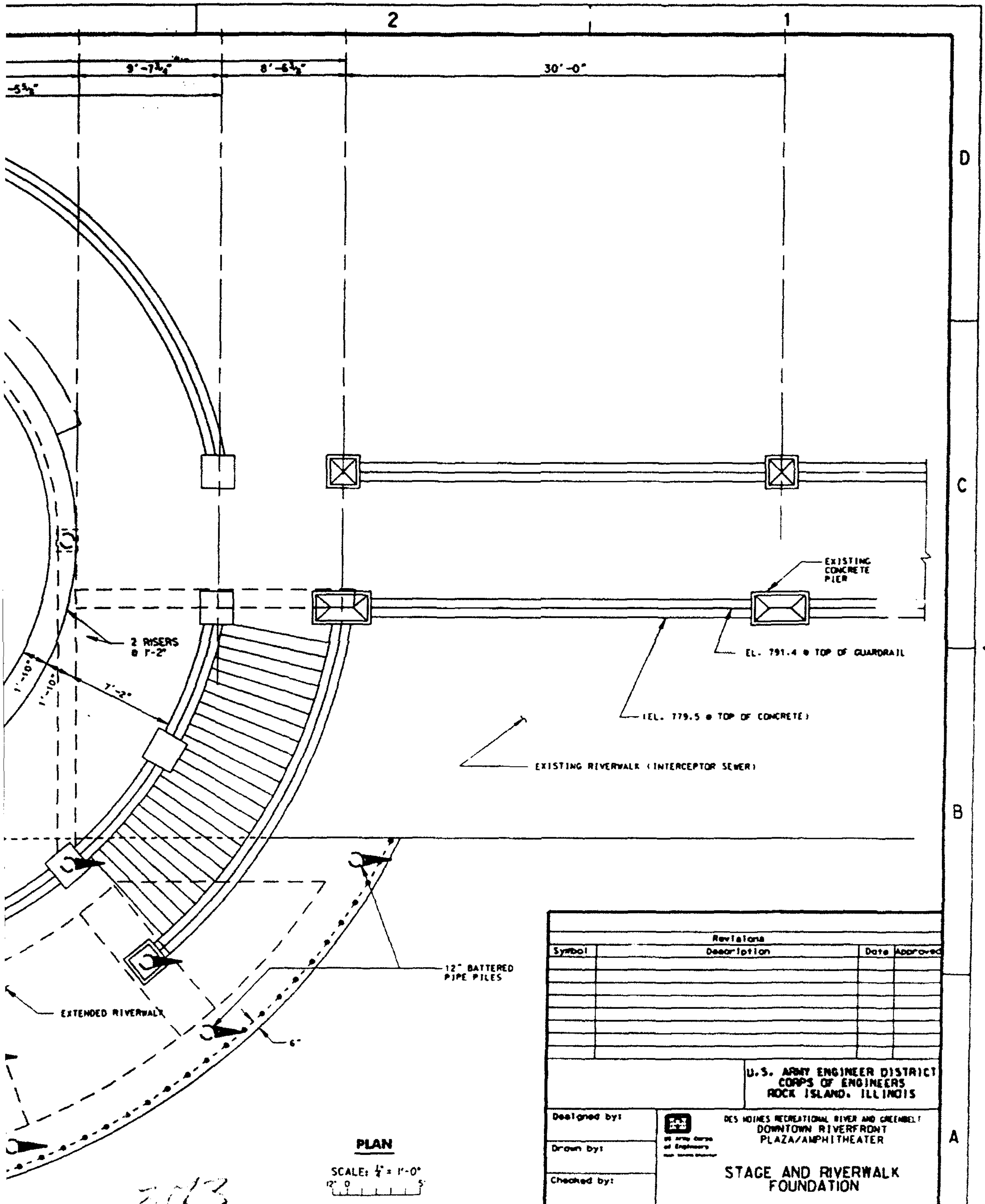


PLAN

SCALE: ¼" = 1'-0"

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by:

Drawn by:

Checked by:

Reviewed by:

Approved by:

DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

STAGE AND RIVERWALK
FOUNDATION

Scale: AS SHOWN

Date:

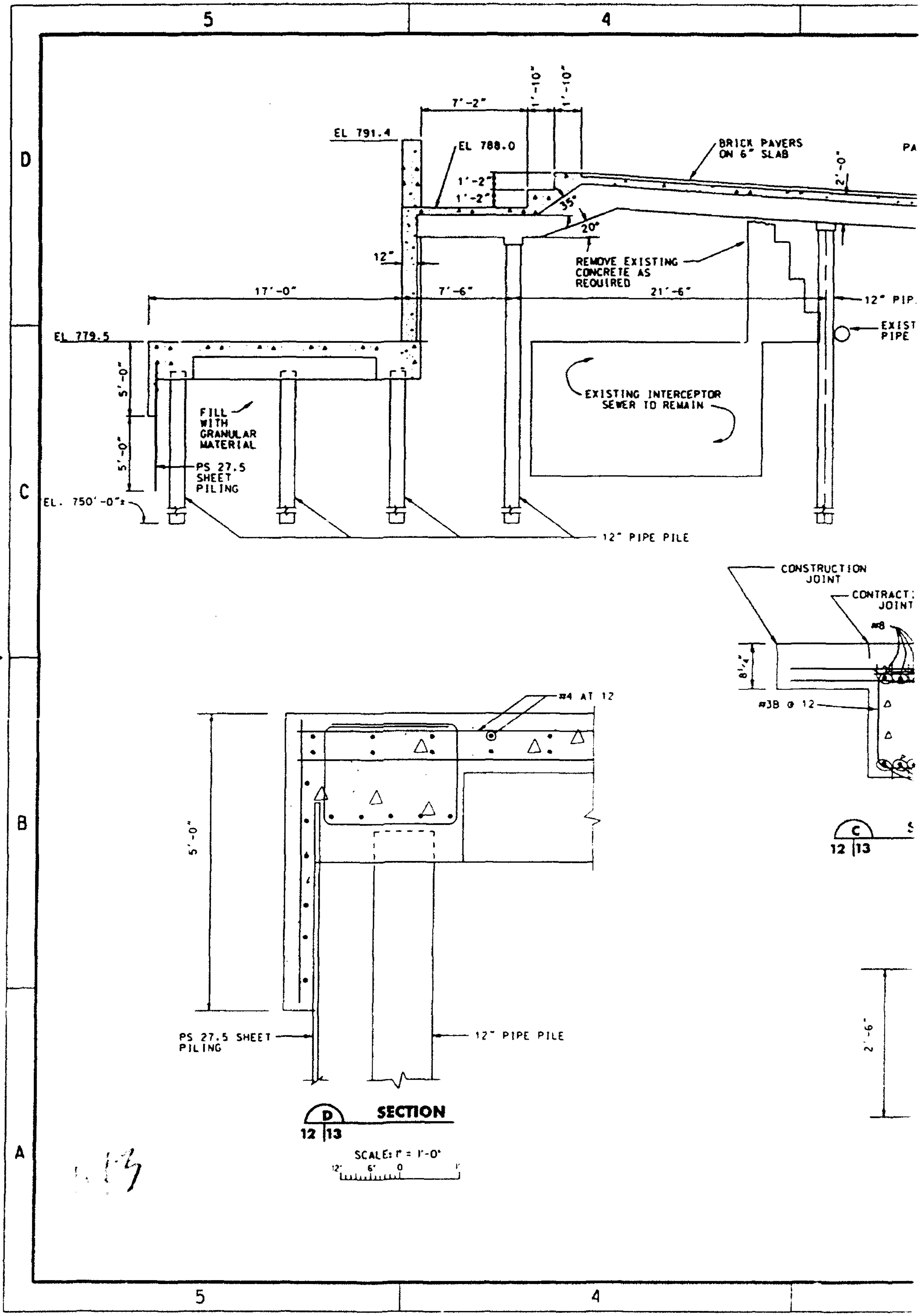
Drawing Code:

Sheet reference number: S-2

Solicitation Number: DACW25-9 -B-

Sheet of

2 1



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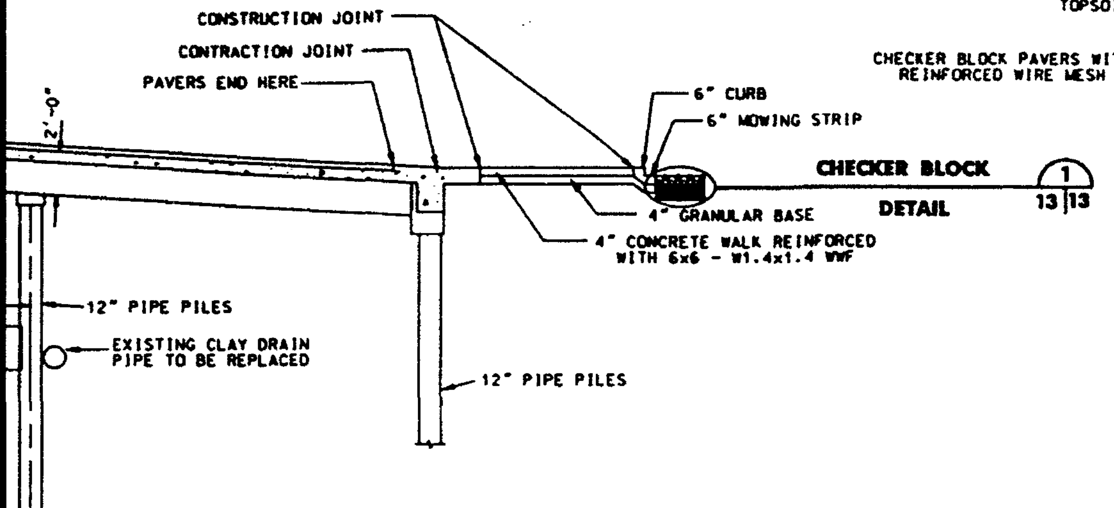
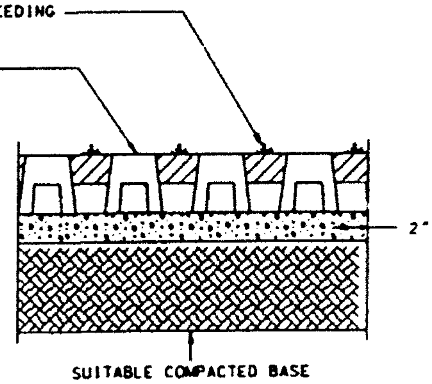


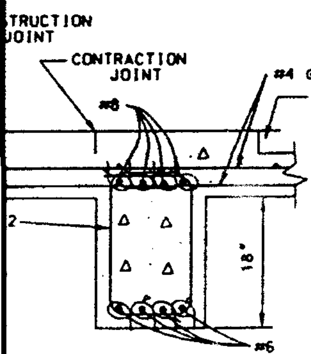


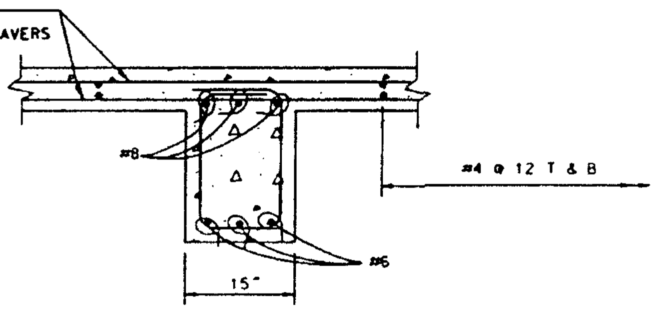
CHECKER BLOCK DETAIL 1 13|13

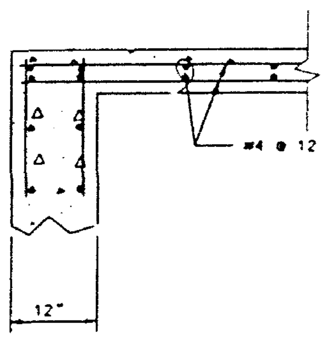
SCALE: ½" = 1'-0"

A 12|13 **SECTION**

SCALE: ¼" = 1'-0"





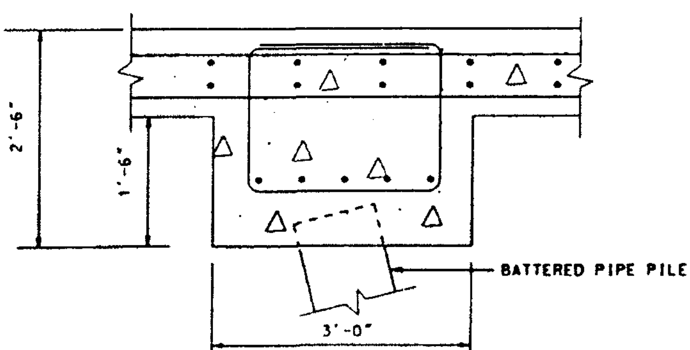


E 12|13 **SECTION**

C 12|13 **SECTION**

B 12|13 **SECTION**

SCALE: 1" = 1'-0"



9 13

F 12|13 **SECTION**

SCALE: 1" = 1'-0"

Revisions		
Symbol	Description	D

U.S. ARMY ENGINEER
CORPS OF ENGI
ROCK ISLAND, IL

Designed by:	DES MOINES RECREATIONAL RIVER AN… DOWNTOWN RIVERFRO… PLAZA/AMPHITHEAT…
Drawn by:	
Checked by:	STAGE AND RIVERW… CROSS SECTIONS
Reviewed by:	Scale: AS SHOWN; Sheet reference number: S-3; Solicitation DACW25-9
Approved by:	Date: ; Drawing Code: ; Sheet

3	2	1

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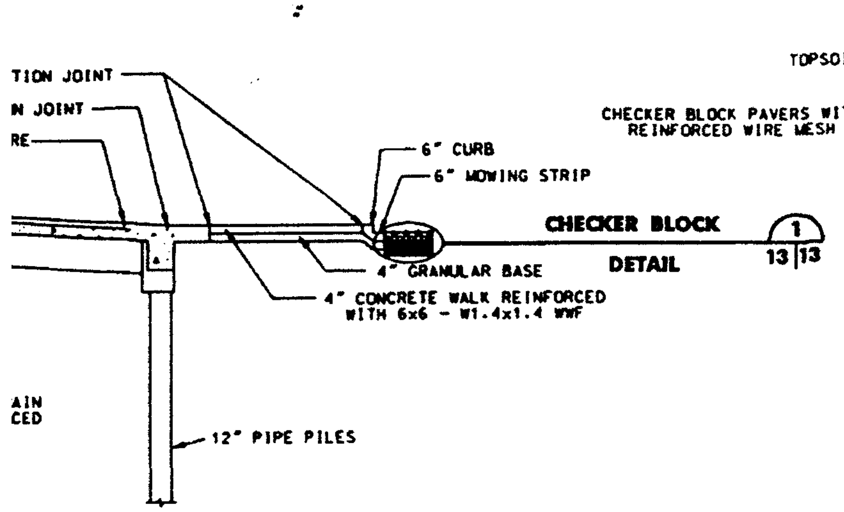
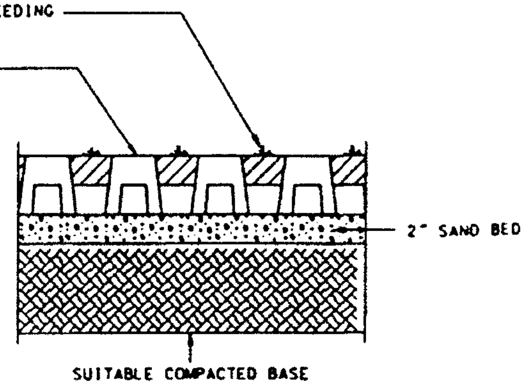


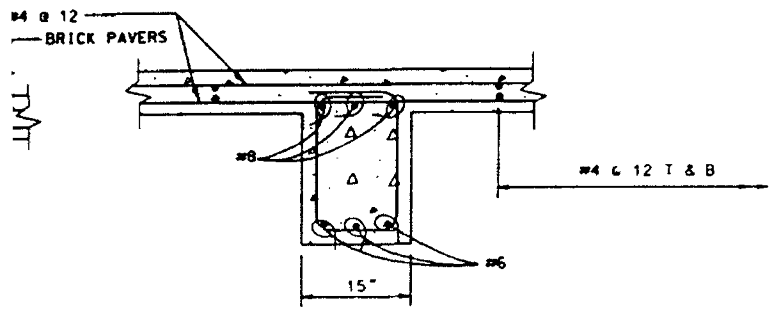
SECTION

CALE: 1/4" = 1'-0"



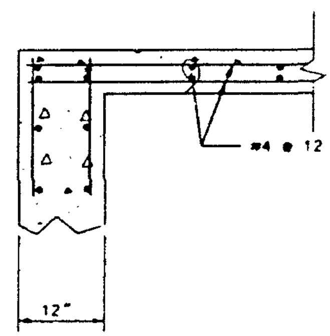
CHECKER BLOCK DETAIL 1 13|13

SCALE: 1/2" = 1'-0"

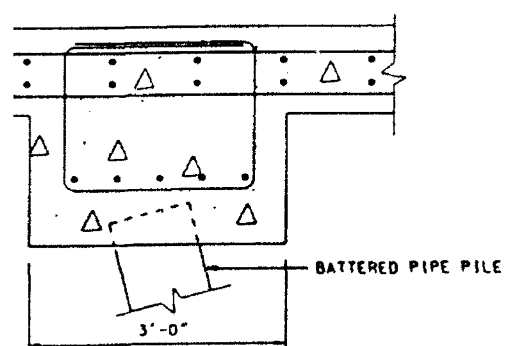


B 12|13 SECTION

SCALE: 1" = 1'-0"



E 12|13 SECTION



F 12|13 SECTION

SCALE: 1" = 1'-0"

3/13

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by:
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Reviewed by:
Approved by:

DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

STAGE AND RIVERWALK
CROSS SECTIONS

Scale: AS SHOWN
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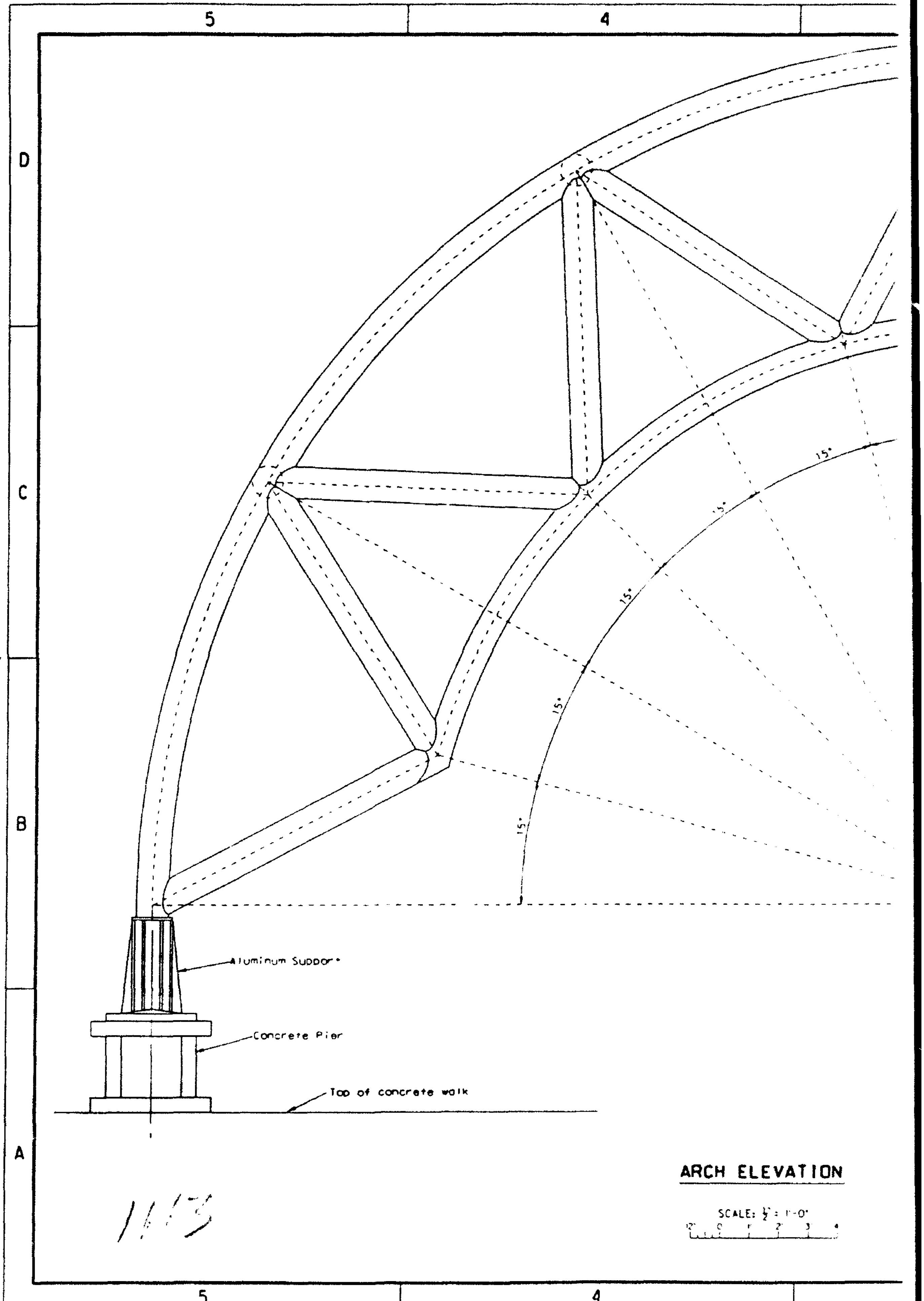
Drawing Code:
Sheet reference number: S-3
Solicitation Number: DACW25-9 -B-
Sheet of

PLATE 13



ARCH ELEVATION

SCALE: ½" = 1'-0"

1113

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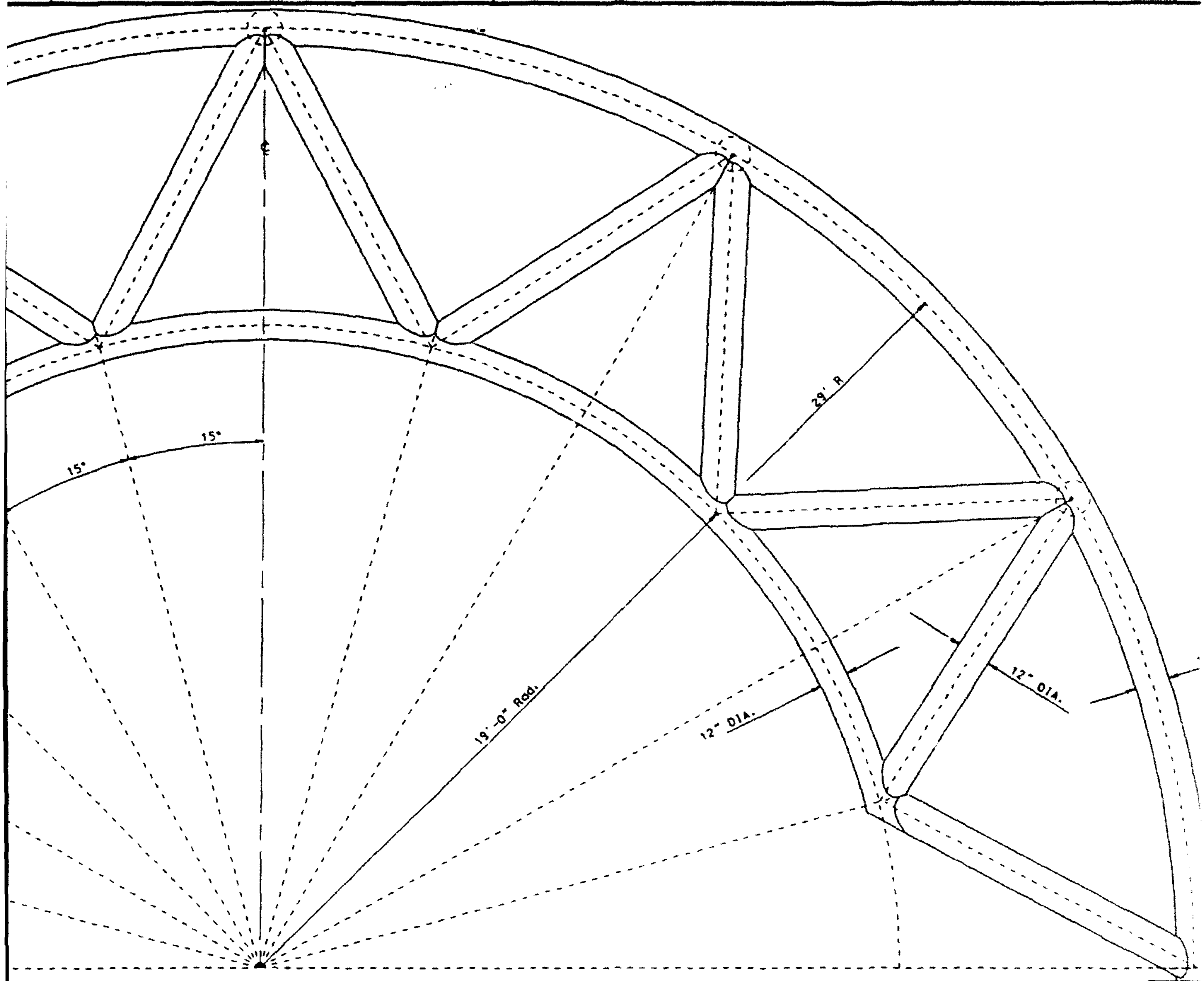
3	2	1



GENERAL NOTES:

1. ALL MEMBERS SHALL BE 6061-T6 ALUMINUM 12" DIA. TUBE WITH 1/4" WALL THICKNESS.
2. CONCRETE fc'? 4,000 PSI AND USE ASTM A615 GRADE 60 DEFORMED REBARS.
3. NEW CONCRETE PIER SHALL MATCH EXISTING CONCRETE MATERIAL AND FINISH.

EVATION

' = 1'-0"

2' 3' 4'

2063

Revisions	
Symbol	Description

U.S. ARMY E
CORPS O
ROCK ISL

Designed by:

Drawn by:

Checked by:

Reviewed by:

Approved by:

US Army Corps of Engineers

DES MOINES RECREATIONAL
DOWNTOWN R
PLAZA/AMP

ARCH ELEVA

Scale:

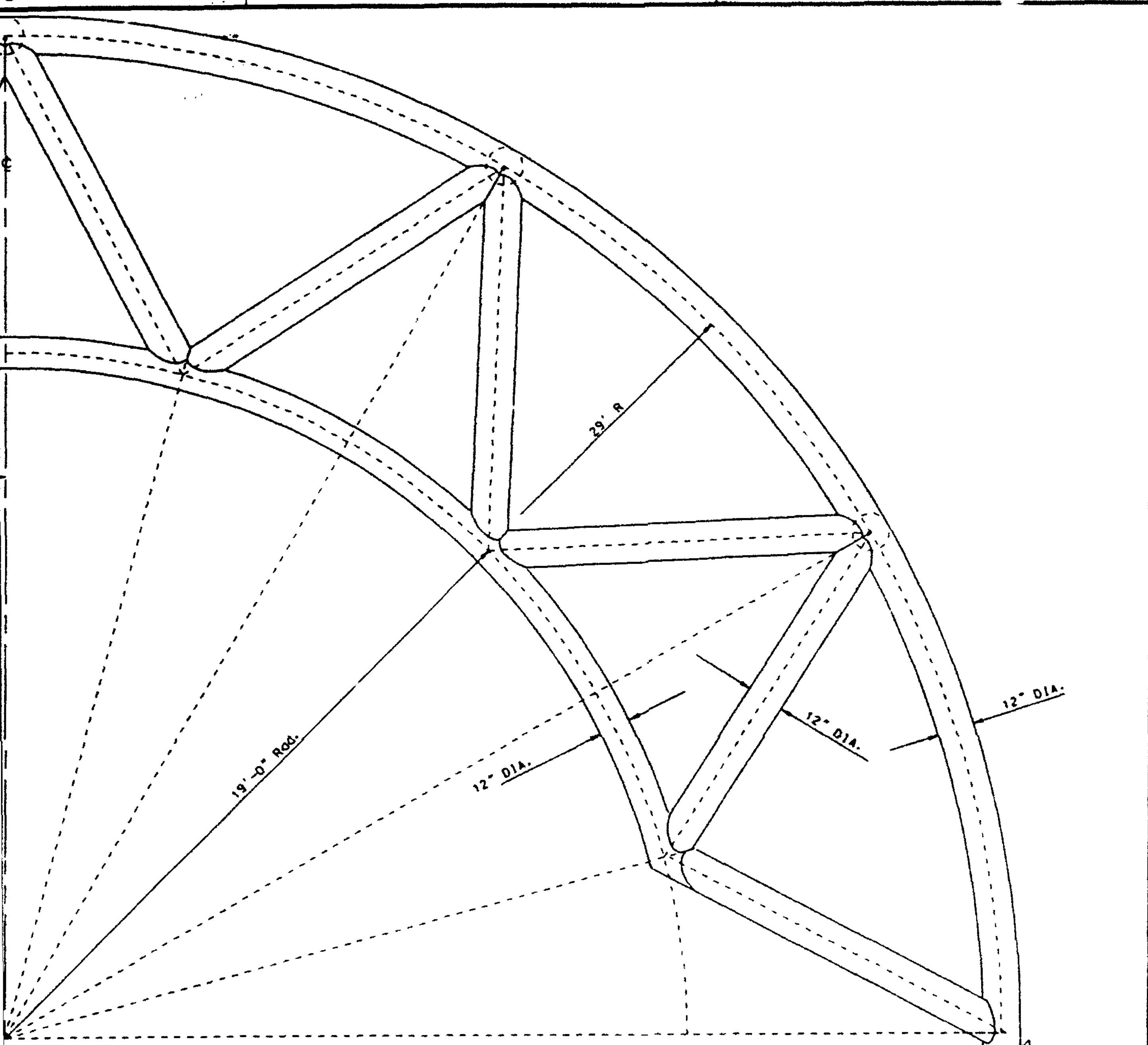
Date:

Drawing Code:

Sheet reference number: S-4

3	2	1

3	2	1



NERAL NOTES:

ALL MEMBERS SHALL BE 6061-T6 ALUMINUM 12" DIA. TUBE WITH 1/4" WALL THICKNESS.

CONCRETE fc' ≥ 4,000 PSI AND USE ASTM A615 GRADE 60 DEFORMED REBARS.

NEW CONCRETE PIER SHALL MATCH EXISTING CONCRETE MATERIAL AND FINISH.

3063

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by:	US Army Corps of Engineers — DES MOINES RECREATIONAL RIVER AND GREENBELT DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER
Drawn by:	
Checked by:	ARCH ELEVATION
Reviewed by:	Scale: / Sheet reference number: S-4
Approved by:	Date: / Solicitation number: DACW25-9 -B- / Drawing Code: / Sheet of

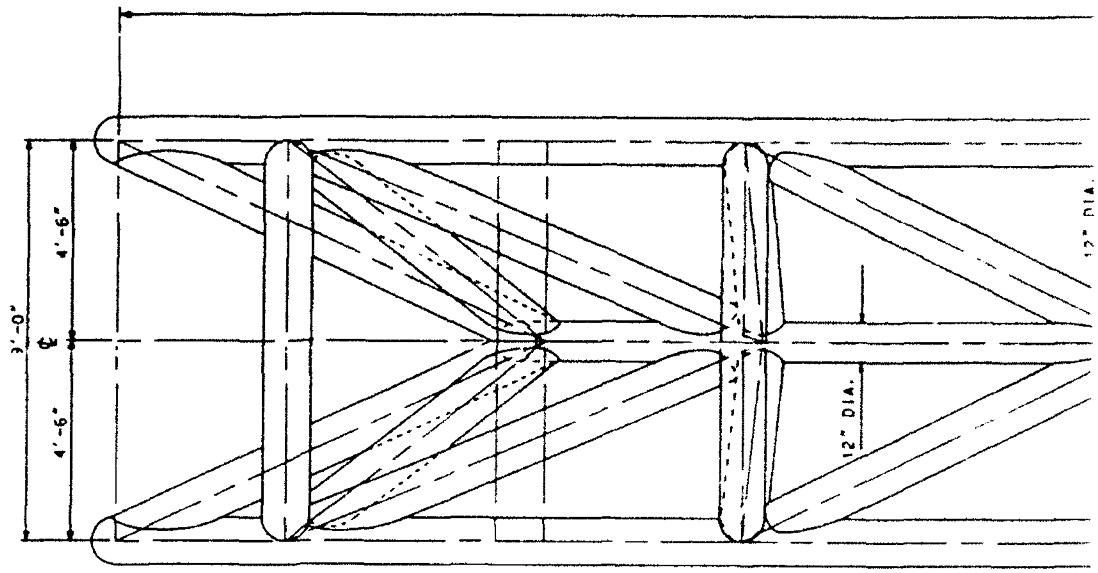
A

3	2	1

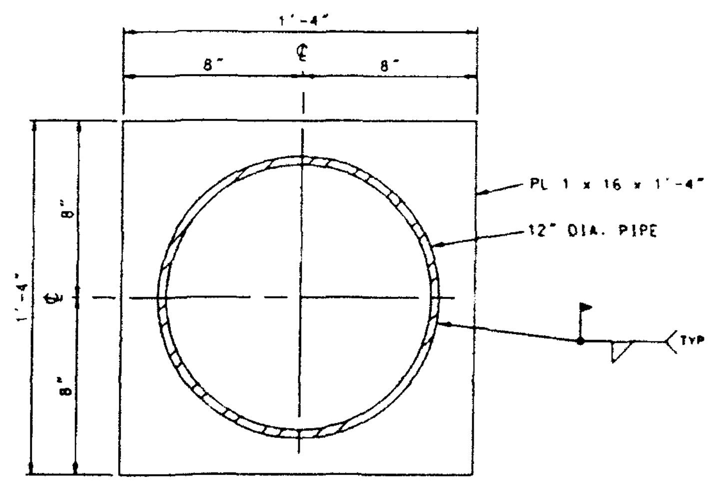
5 4

D

C



B



(STIFFENER PLATES & CONCRETE PIER NOT SHOWN)

A

SUPPORT DETAIL

SCALE: 3" = 1'-0"

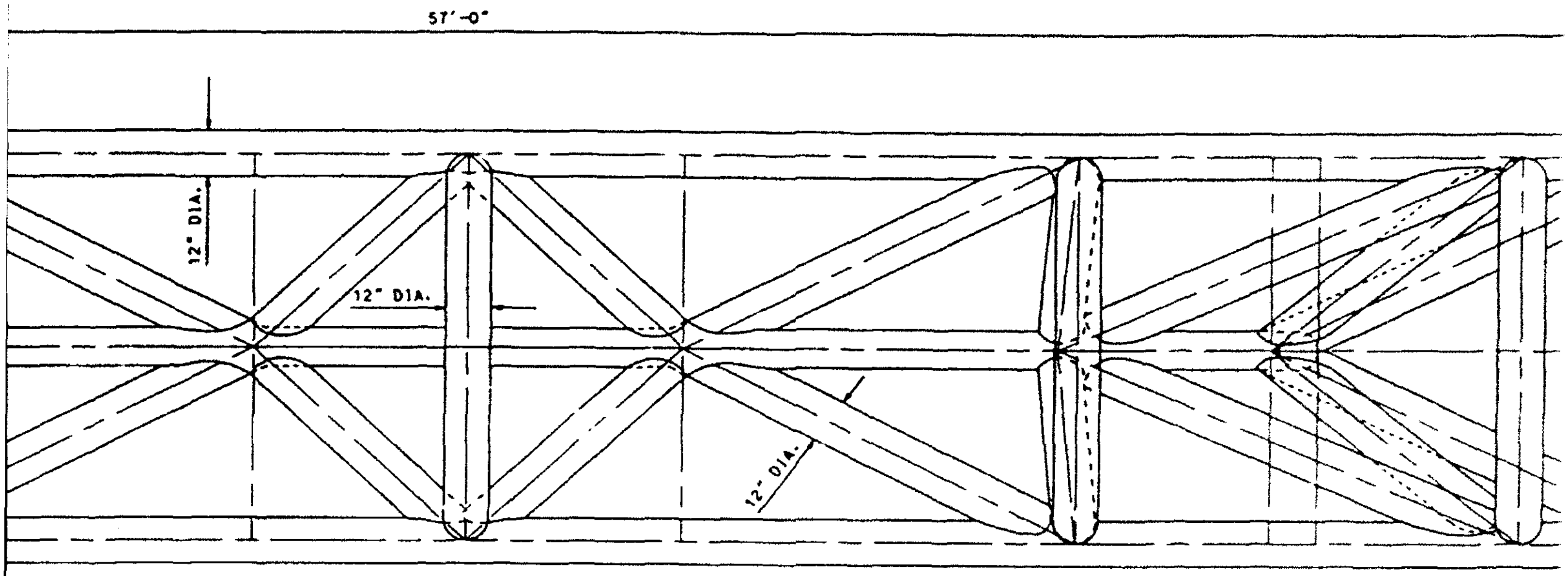
0 3" 6" 12"

1-13

5 4

11-AUG-1992 14:55
/usr3/projects/gb04/gb04a003.dgn

3	2	1



ARCH PLAN VIEW

SCALE: $\frac{1}{2}$" = 1'-0"

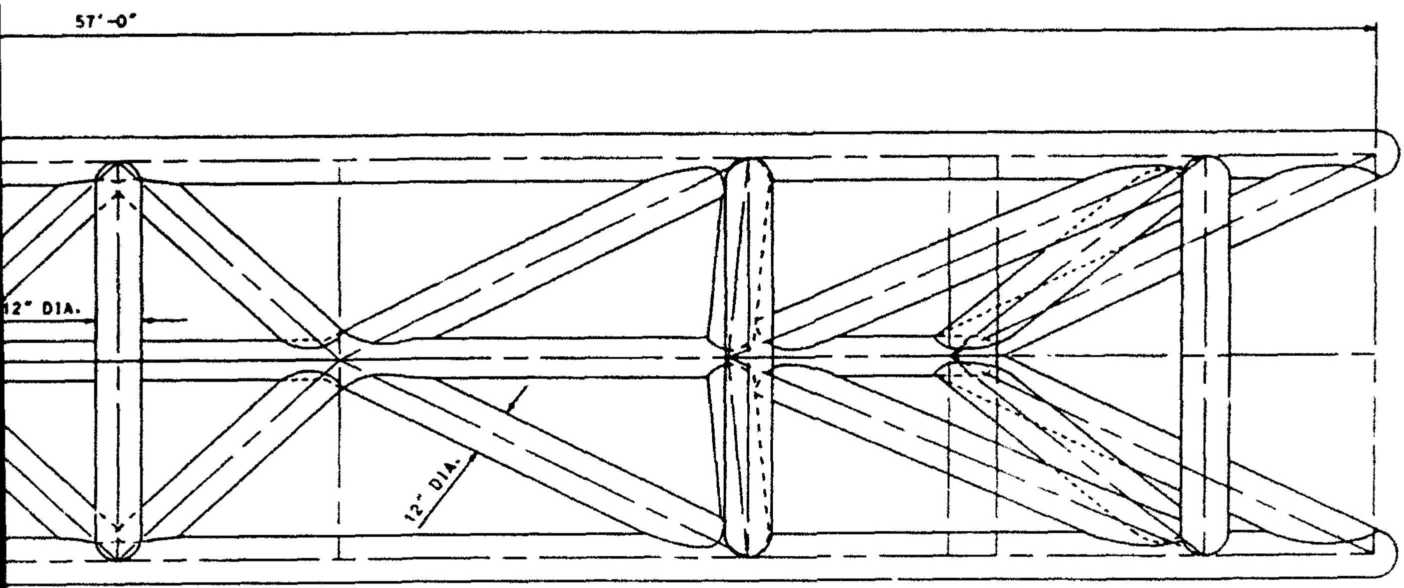
293

Revisions	
Symbol	Description

U.S. ARMY E
CORPS O
ROCK ISL

Designed by:	US Army Corps of Engineers — DES MOINES RECREATIONA DOWNTOWN R PLAZA/AMP	
Drawn by:	ARCH PLAN VIEW SUPPORT DE	
Checked by:		
Reviewed by:	Scale: AS SHOWN	Sheet reference number: S-5
Approved by:	Date:	
	Drawing Code:	

3	2	1



ARCH PLAN VIEW

SCALE: 1/2" = 1'-0"

0 1' 2' 3' 4'

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by:	DES MOINES RECREATIONAL RIVER AND GREENBELT DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER
Drawn by:	
Checked by:	ARCH PLAN VIEW AND SUPPORT DETAIL
Reviewed by:	Scale: AS SHOWN
	Date:
Approved by:	Drawing Code:

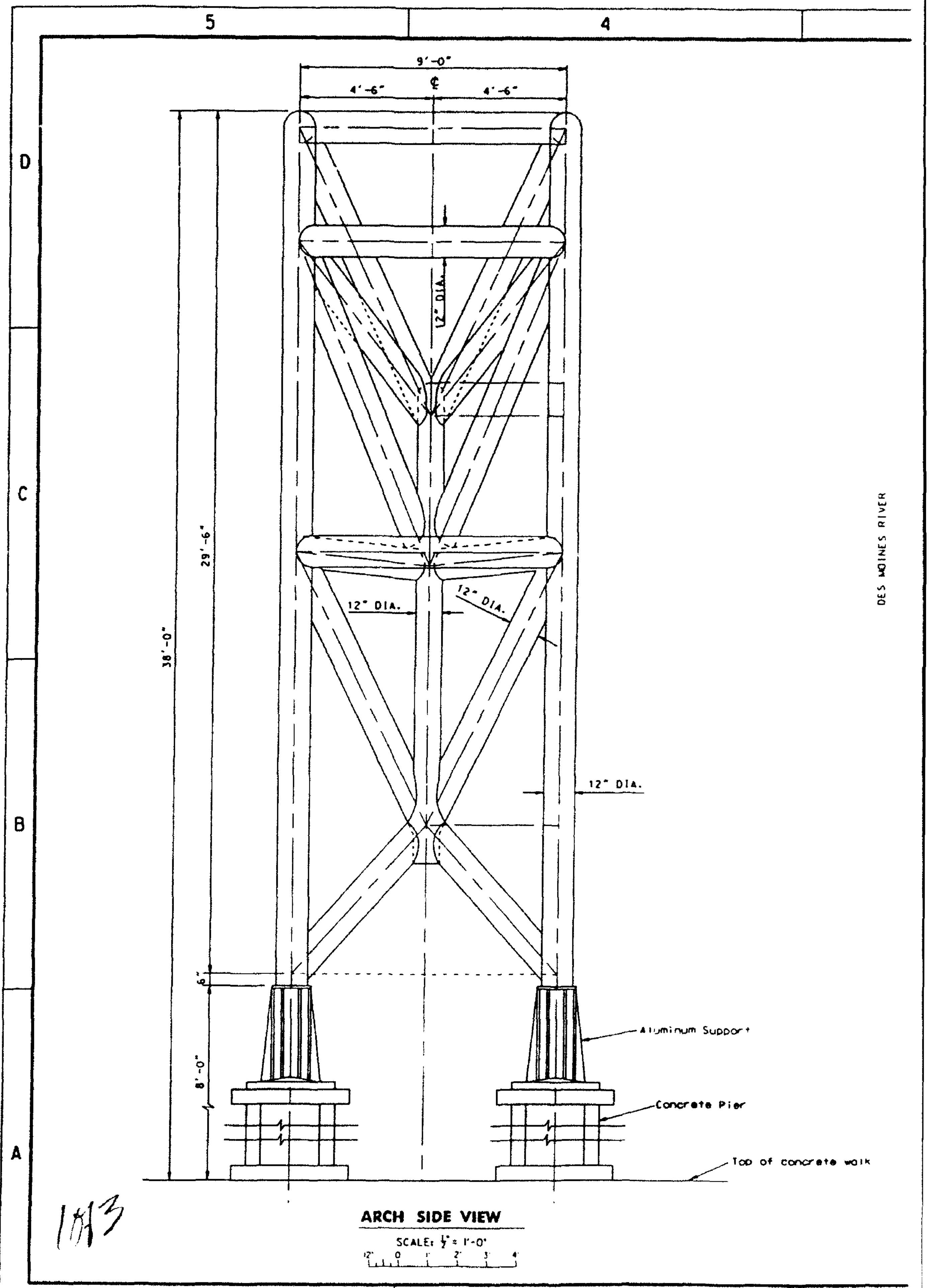
Sheet reference number: S-5

Solicitation Number: DACW25-9 -B-

Sheet of

3063

PLATE 15

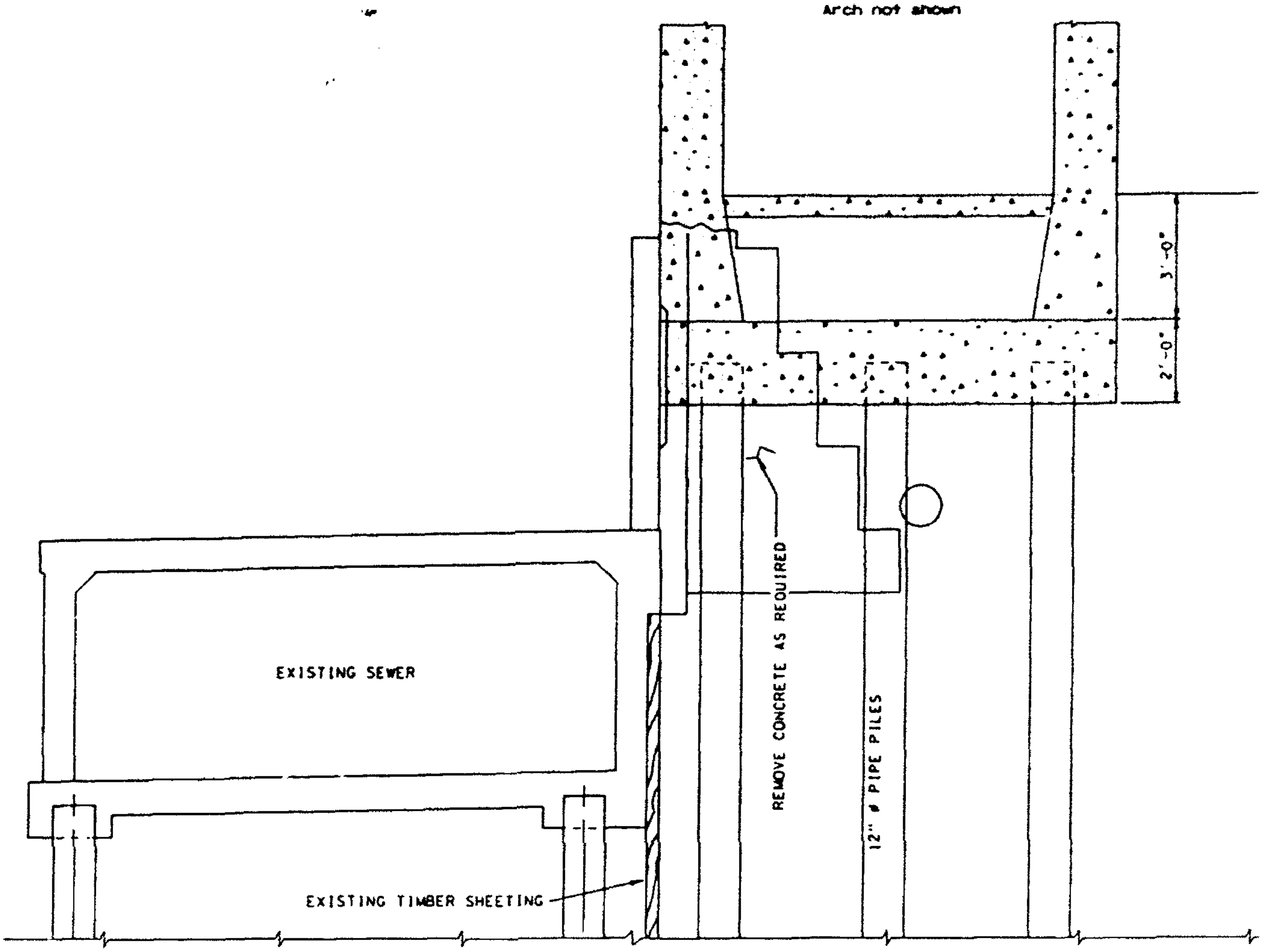


ARCH SIDE VIEW

SCALE: $\frac{1}{2}$" = 1'-0"

11-AUG-1992 14:57
/usr3/projects/gb04/gb04s002.dgn

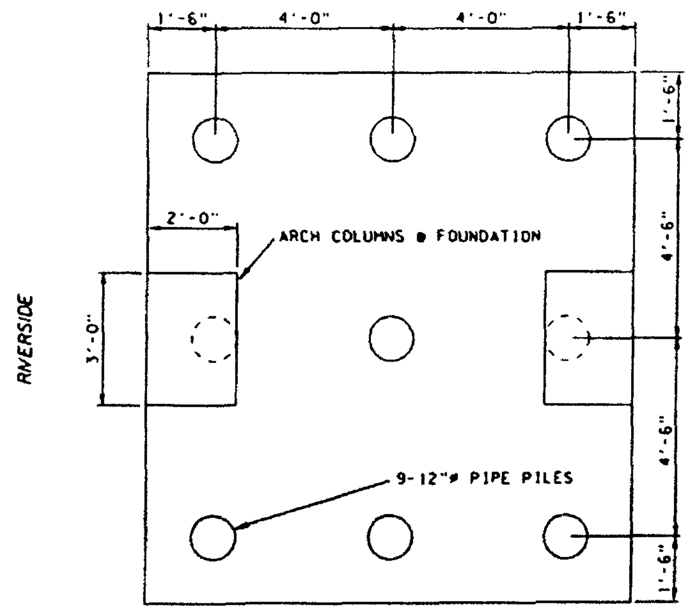
3 | 2 | 1



ARCH FOUNDATION ELEVATION

SCALE: ½" = 1'-0"

NOTE:
DRIVE PILES T
ESTIMATED LE



p of concrete walk

2163

ARCH FOUNDATION PLAN

SCALE: ½" = 1'-0"

Symbol	Revisions Description

U.S. ARMY CORPS ROCK IS

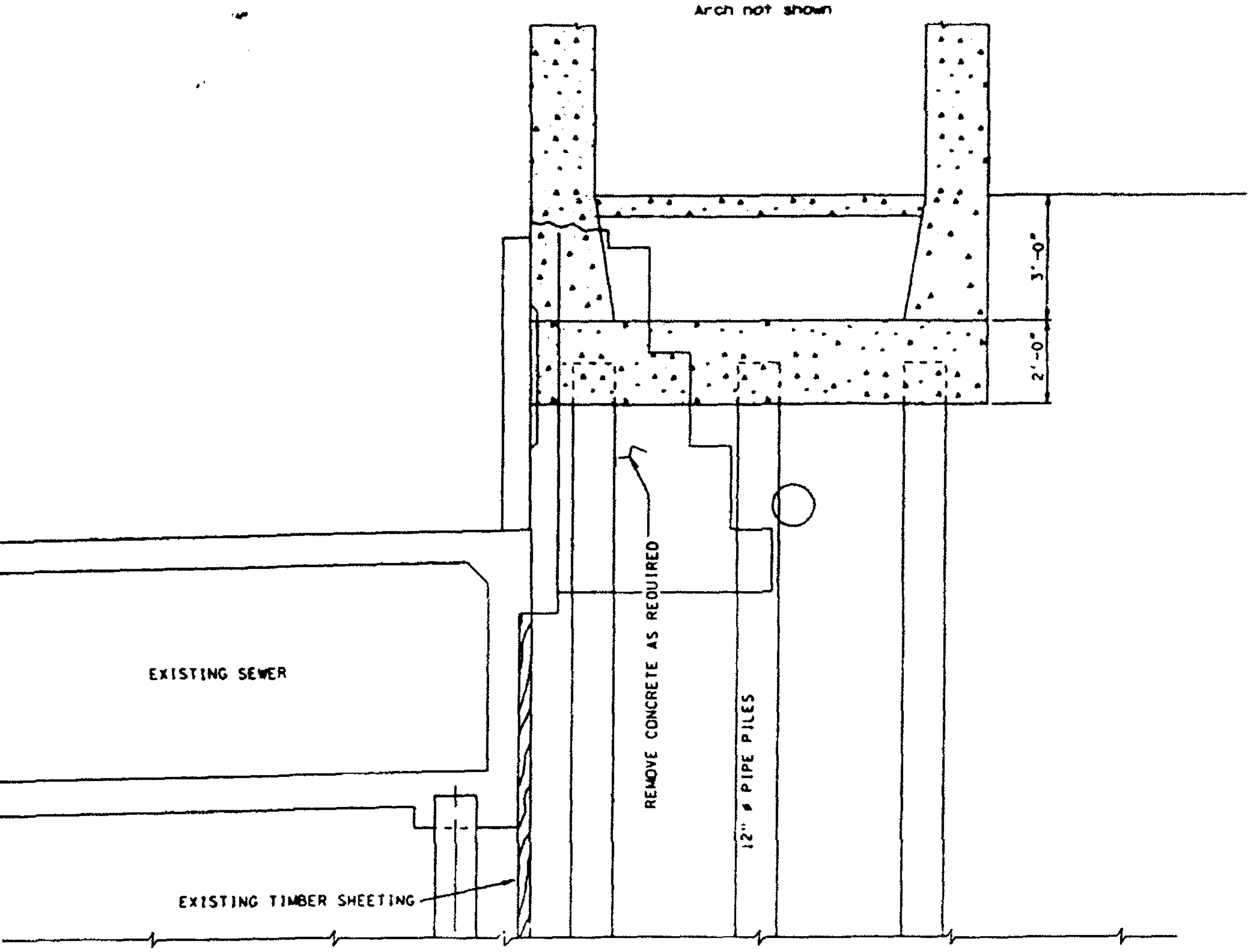
Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by:

DES MOINES RECREATIO
DOWNTOWN
PLAZA/AM

ARCH SIDE VIE
FOUNDATI

Scale: AS SHOWN
Date:
Drawing Code:
Sheet reference number: S-6

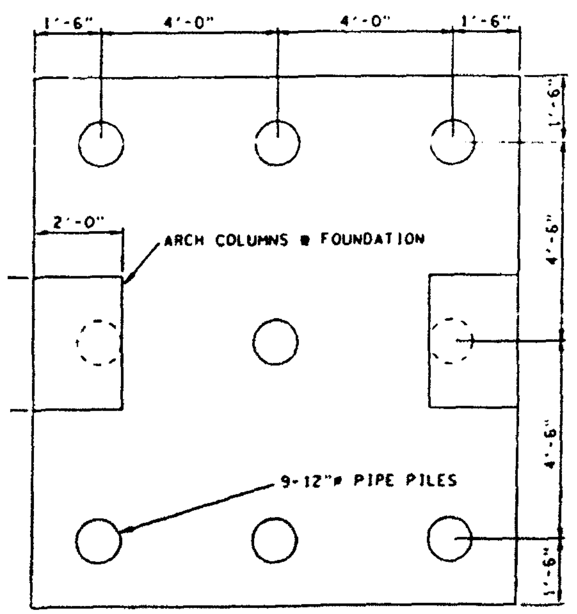
3 | 2 | 1



ARCH FOUNDATION ELEVATION

SCALE: ½" = 1'-0"

NOTE:
DRIVE PILES TO REFUSAL.
ESTIMATED LENGTH 40 FT.



ARCH FOUNDATION PLAN

SCALE: ½" = 1'-0"

313

Revisions

Symbol	Description	Date	Approved

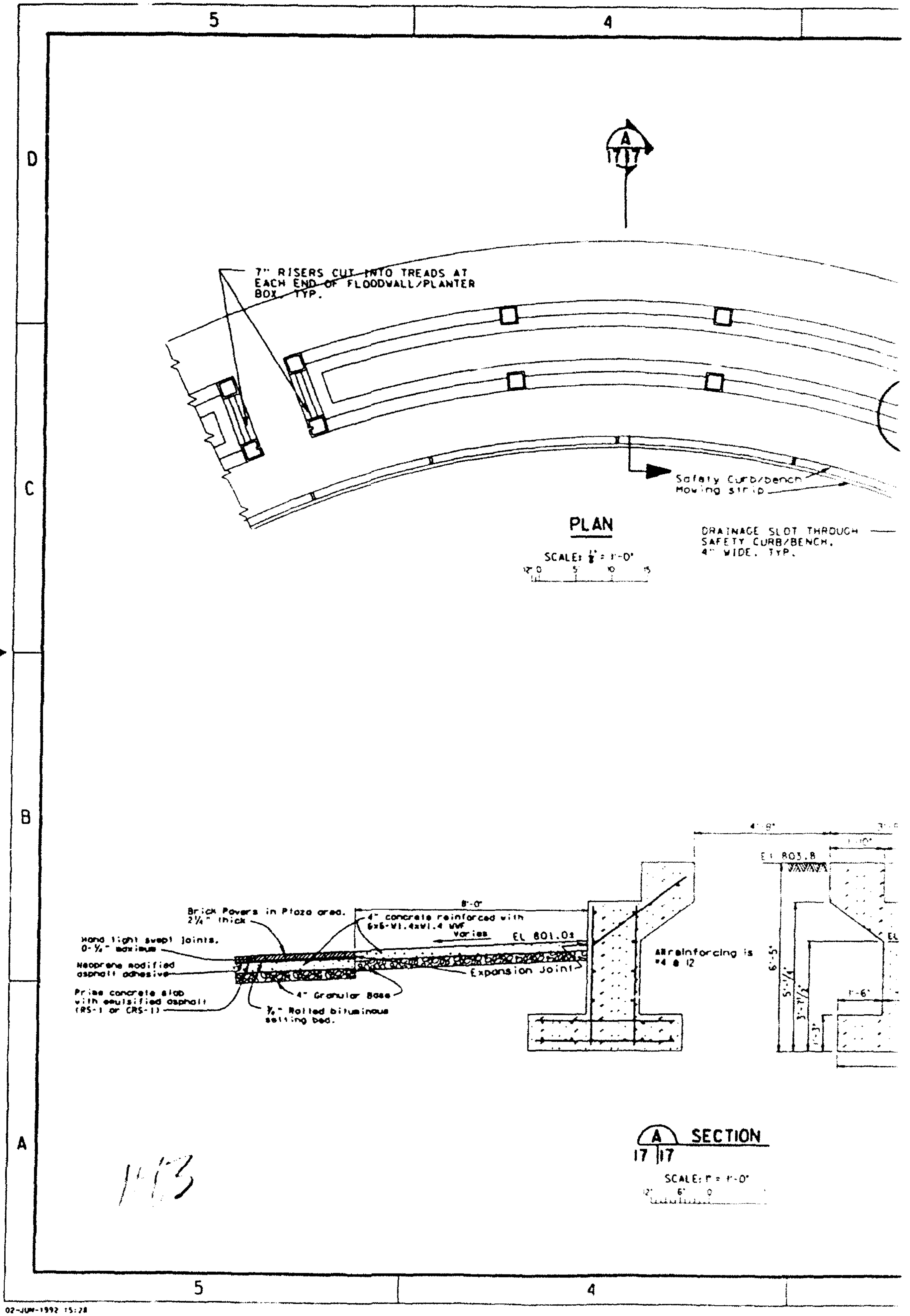
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by:

DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

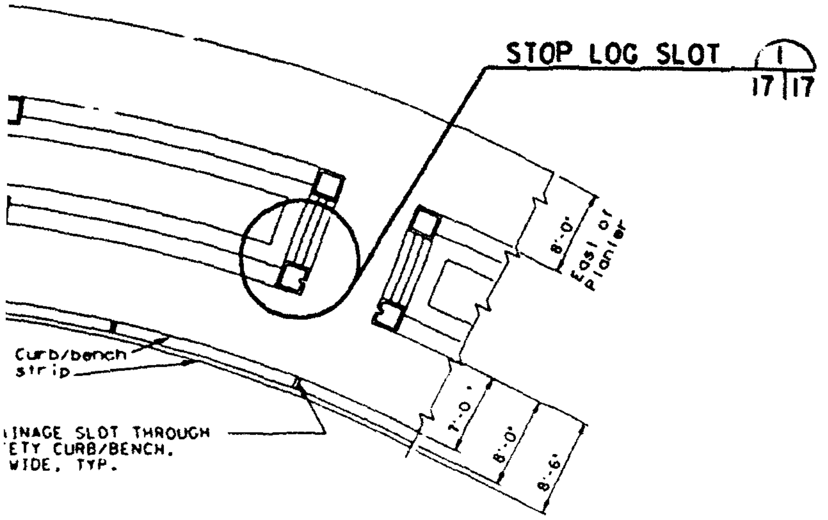
ARCH SIDE VIEW AND FOUNDATION

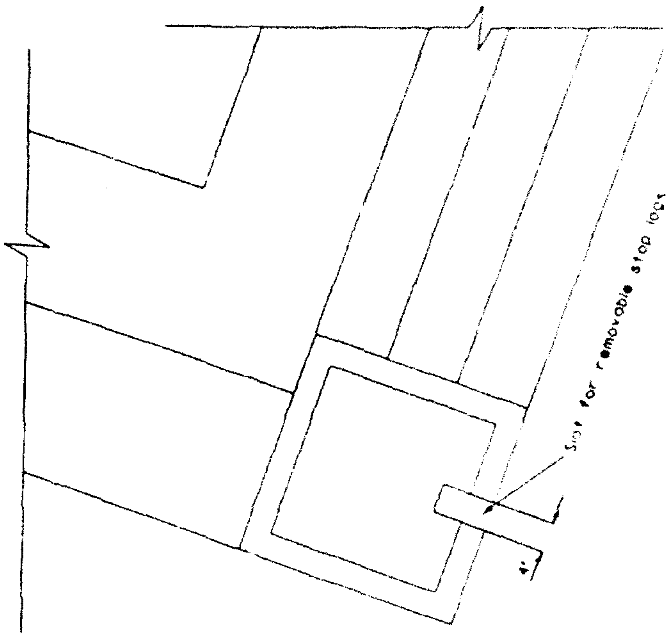
Scale: AS SHOWN
Date:
Drawing Code:
Sheet reference number: S-6
Solicitation Number: DACW25-9 -B-
Sheet of



02-JUN-1992 15:28
/big1/gb04/plantbox.dgn

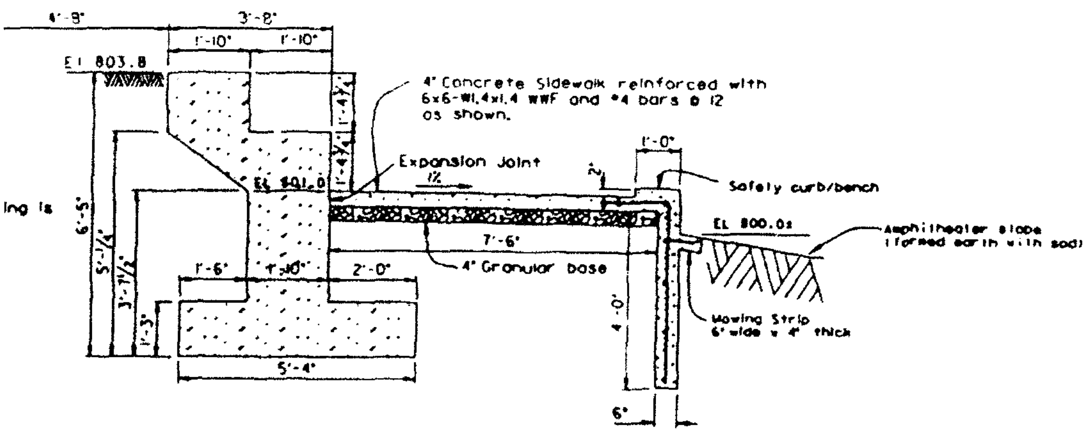
	3	2	





STOP LOG SLOT (1 / 17 | 17)

SCALE: 1" = 1'-0"



TION

1'-0"

163

Symbol	Revisions Description

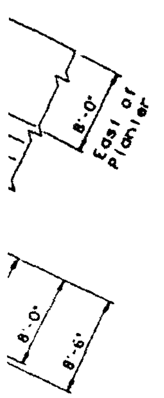
U.S. A
C
ROC

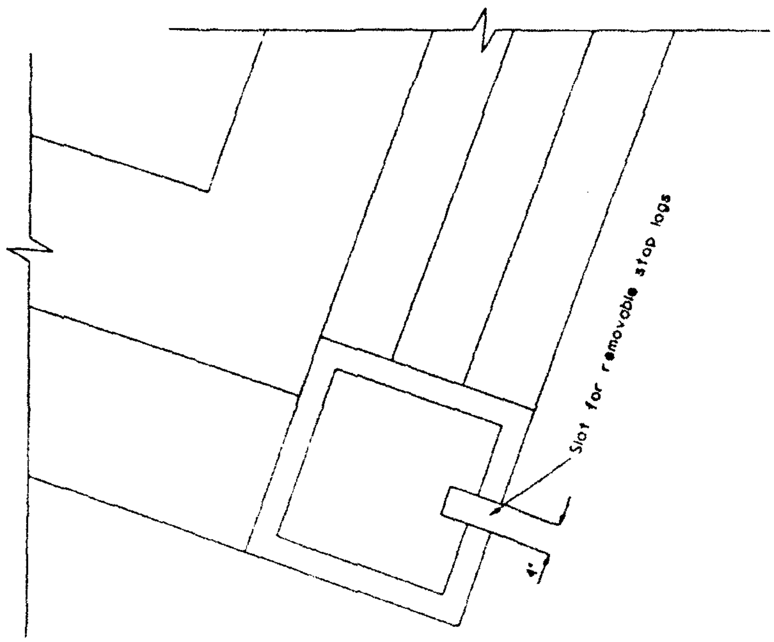
Designed by:	US Army Corps of Engineers	DES MOINES REC DOWN PLAZ
Drawn by:		
Checked by:	FLOODWALL /	
Reviewed by:	Scale:	
Approved by:	Date:	
	Drawing Code:	

	3	2	1

	2	1	

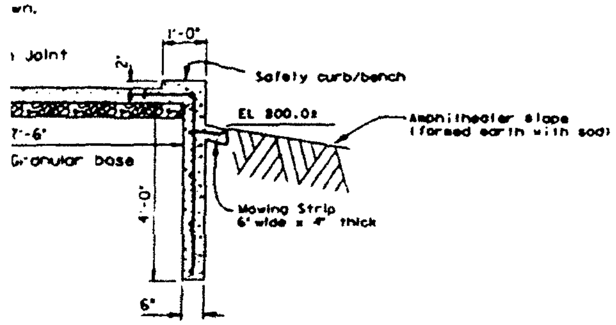
STOP LOG SLOT 1/17|17





STOP LOG SLOT 1/17|17

SCALE: 1" = 1'-0"



	Revisions		
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by:

Drawn by:

Checked by:

Reviewed by:

Approved by:

DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

FLOODWALL / PLANTER BOX

Scale:

Date:

Drawing Code:

Sheet reference number: S-7

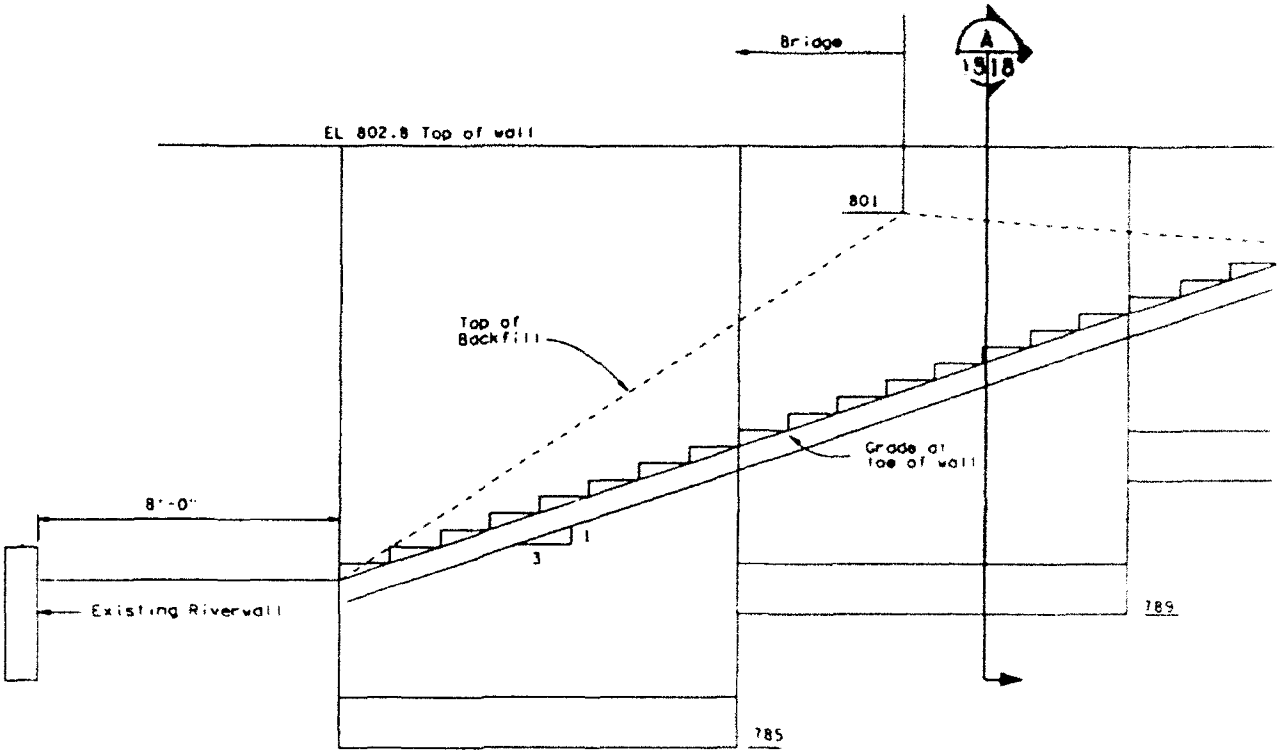
Solicitation Number: DACW25-9 -B-

Sheet of

3163

	2	1	

PLATE 17



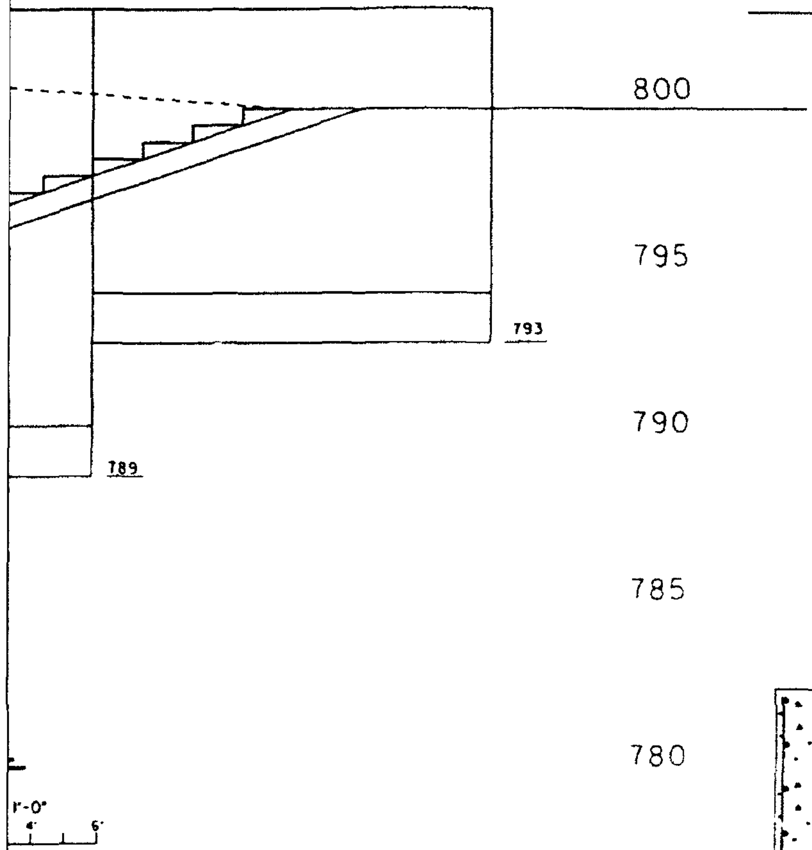
T-WALL

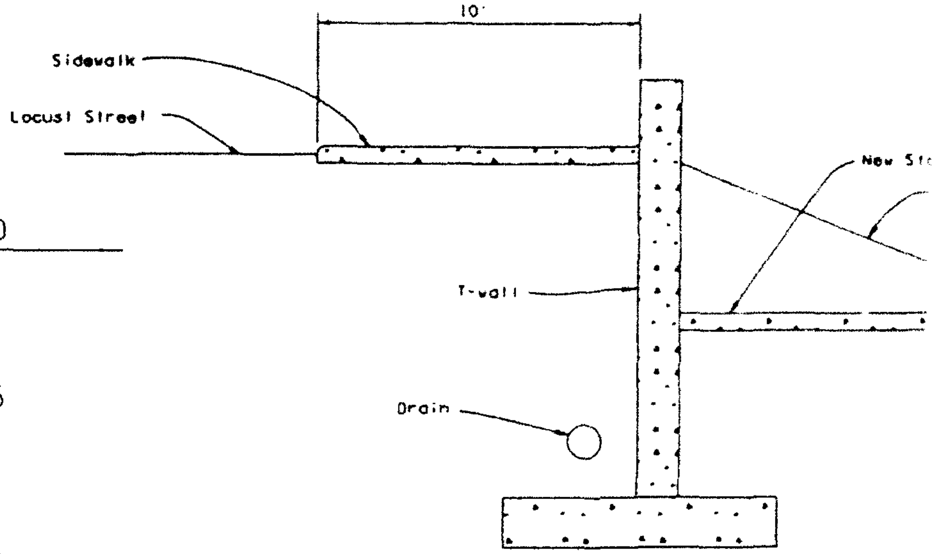
SCALE: $\frac{3}{8}$ = 1'-0"

1-13

02-JUN-1992 15:29
/bigt/gb04/gb04a007.dgn

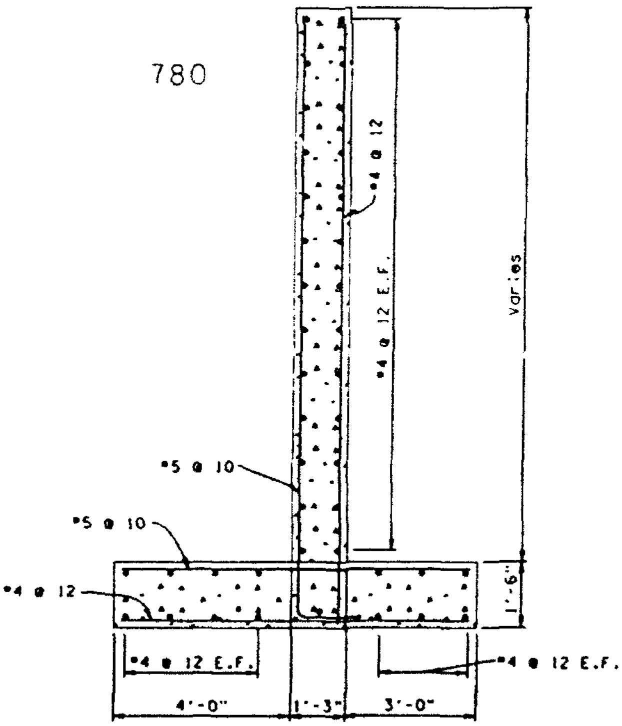
3 | 2 | 1





A SECTION
18|18

SCALE: $\frac{3}{8}$" = 1'-0"



WALL SECTION

SCALE: $\frac{1}{2}$" = 1'-0"

2013

NOTES
1. Concrete to be architecturally trea

Symbol	Revisions Description

U.S. ARM CORP ROCK

Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by:

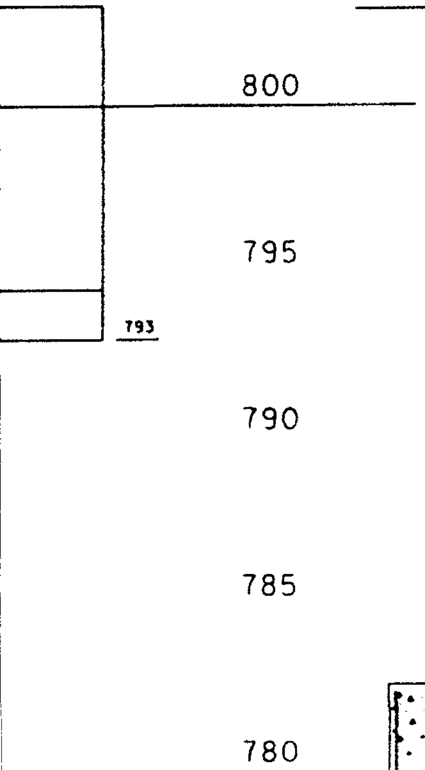
US Army Corps of Engineers

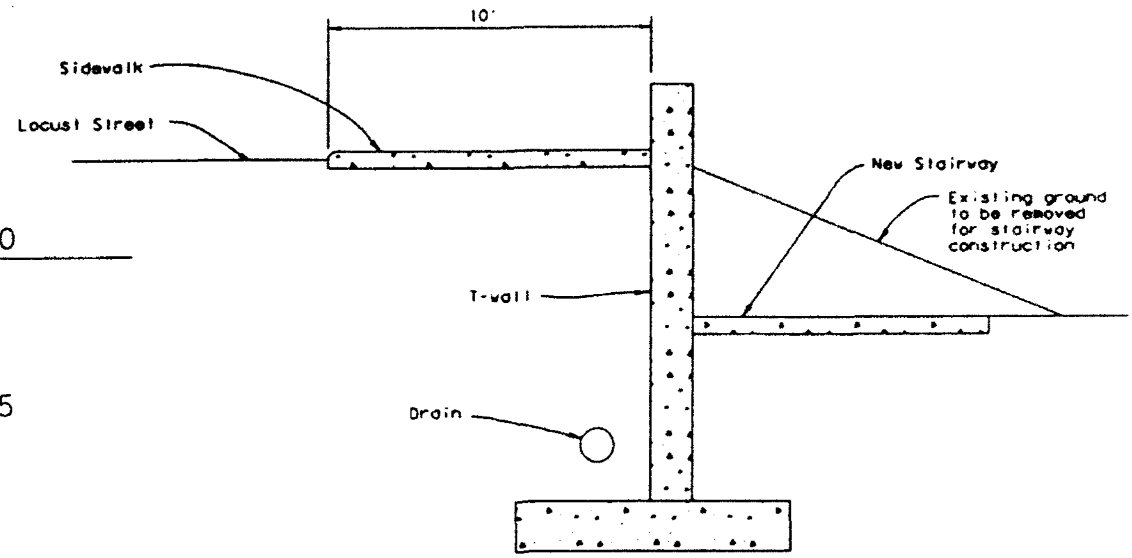
DES MOINES RECREAT DOWNTOW PLAZA/

T-WALL

Scale: AS SHOWN
Date:
Drawing Code:
Sheet reference number: S-E

3 | 2 | 1

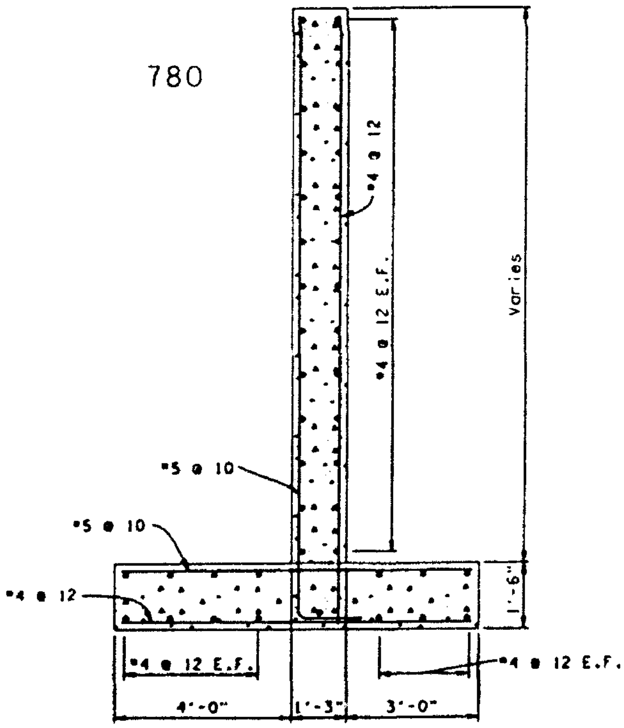




A SECTION
18|18

SCALE: $\frac{3}{8}$" = 1'-0"

NOTES
1. Concrete to be architecturally treated.



WALL SECTION

SCALE: $\frac{1}{2}$" = 1'-0"

3443

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

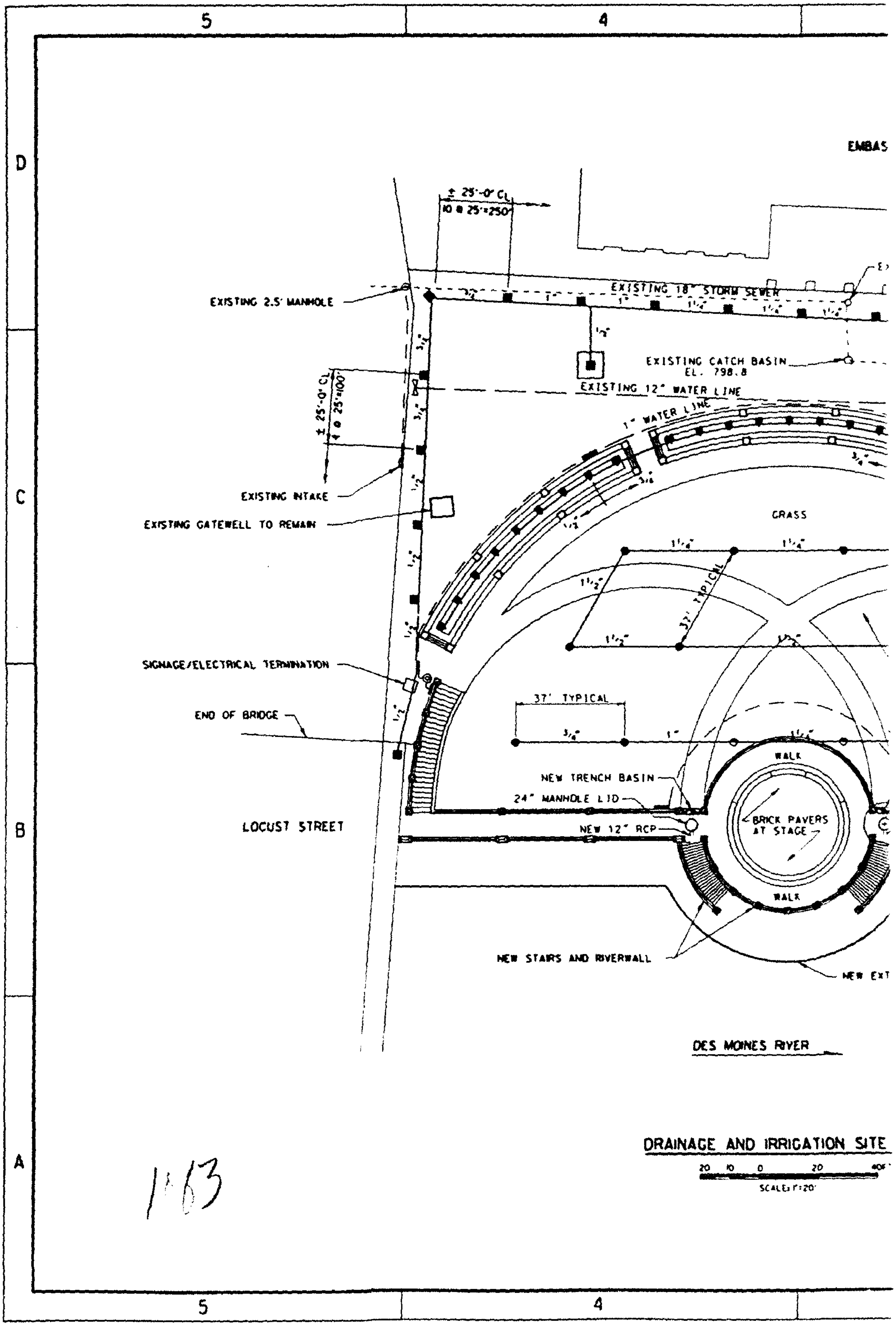
T-WALL DETAILS

Designed by:	
Drawn by:	
Checked by:	
Reviewed by:	Scale: AS SHOWN
Approved by:	Date:
	Drawing Code:

Sheet reference number: S-8

Solicitation Number: DACW25-9 -B-

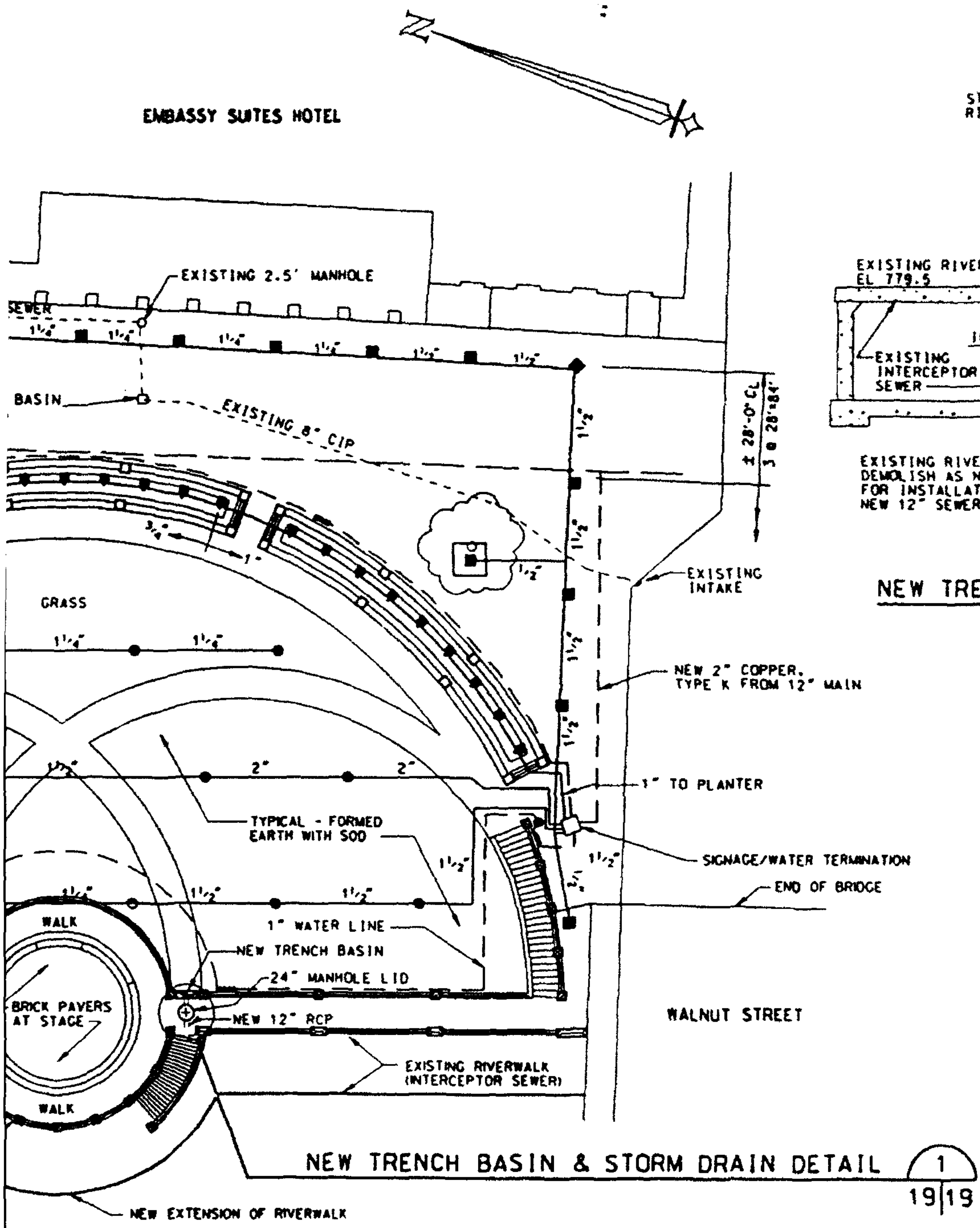
Sheet of



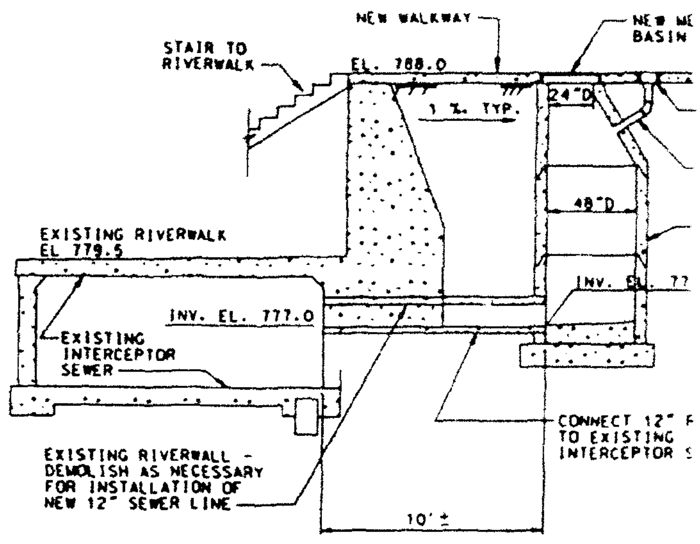
1-63

02-JUN-1992 15:30
/bigl/gb04/gb04m001.dgn

3 | 2 | 1



NEW TRENCH BASIN & STORM DRAIN DETAIL 1 19|19



NEW TRENCH BASIN & STORM DRAIN DETAI

NOT TO SCALE

ES RIVER

D IRRIGATION SITE PLAN

0 20 40FT

SCALE: 1"=20'

LEGEND

- ● 50 PSI, 30'-0" RADIUS, FULL CIRCLE SPRINKLER HEAD
- ◓ 50 PSI, 30'-0" RADIUS, HALF CIRCLE SPRINKLER HEAD
- ■ 20 PSI, FLOOD BUBBLER FOR PLAZA TREES
- ■ 10 PSI, 4" POP-UP BUBBLER FOR SHRUBS IN PLANTERS
- —— CLASS 200 PVC 1/2" TO 2" DIAMETER
- ▬ IN WALL HYDRANT
- ◎ DRINKING FOUNTAIN

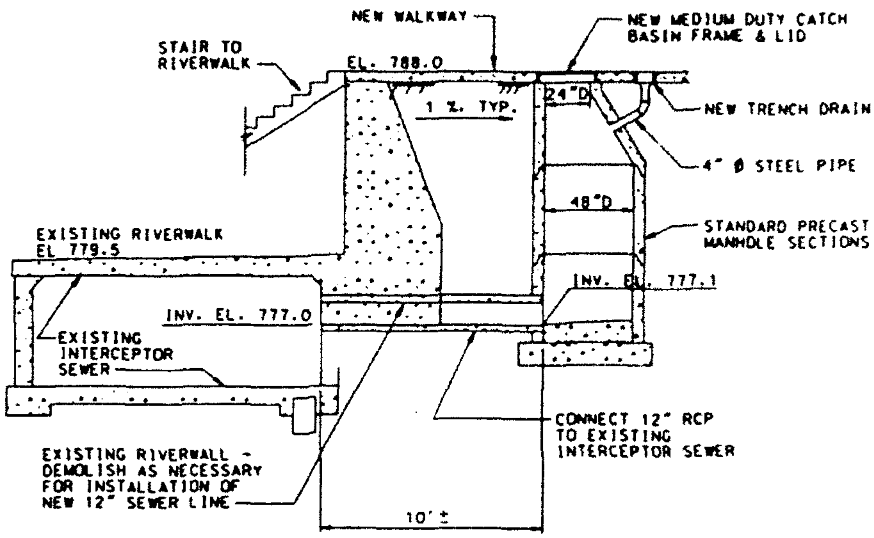
2063

Revisions	
Symbol	Description

U.S. ARMY CORPS ROCK I

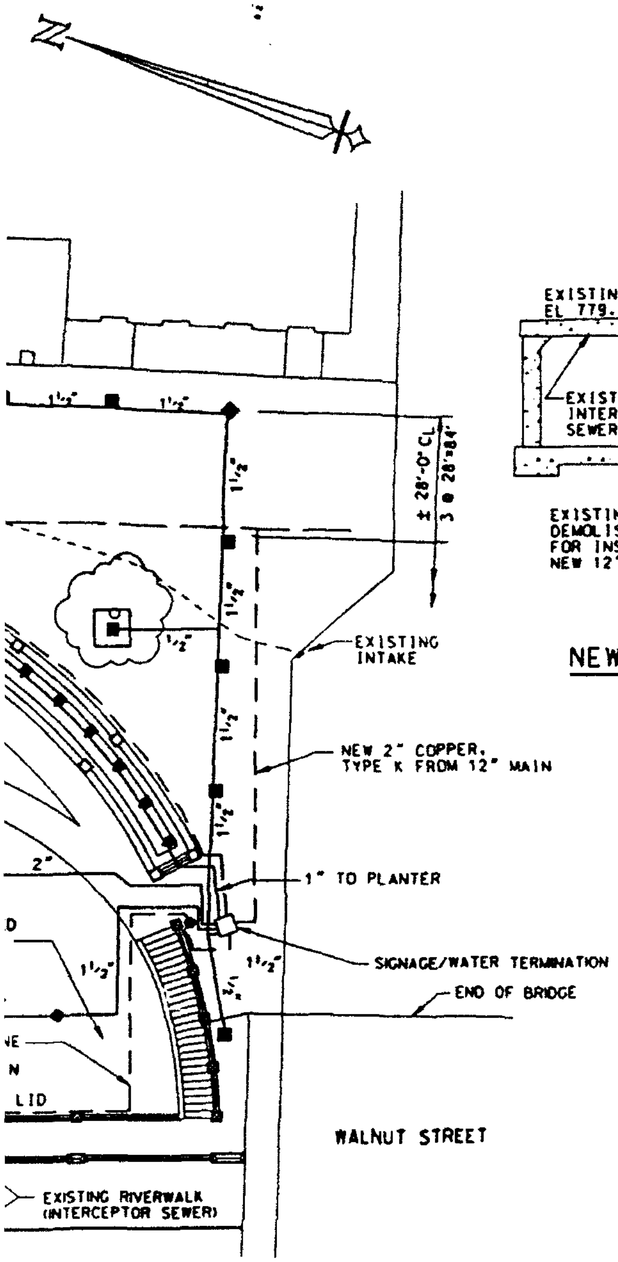
Designed by:	DES MOINES RECREATI DOWNTOWN PLAZA/AV
Drawn by:	
Checked by:	DRAINAGE AND SITE PL
Reviewed by:	Scale: AS SHOWN / Sheet reference number: M-1
Approved by:	Date: / Drawing Code:

3 | 2 | 1



NEW TRENCH BASIN & STORM DRAIN DETAIL 1 19|19

NOT TO SCALE



TRENCH BASIN & STORM DRAIN DETAIL 1 19|19

LEGEND

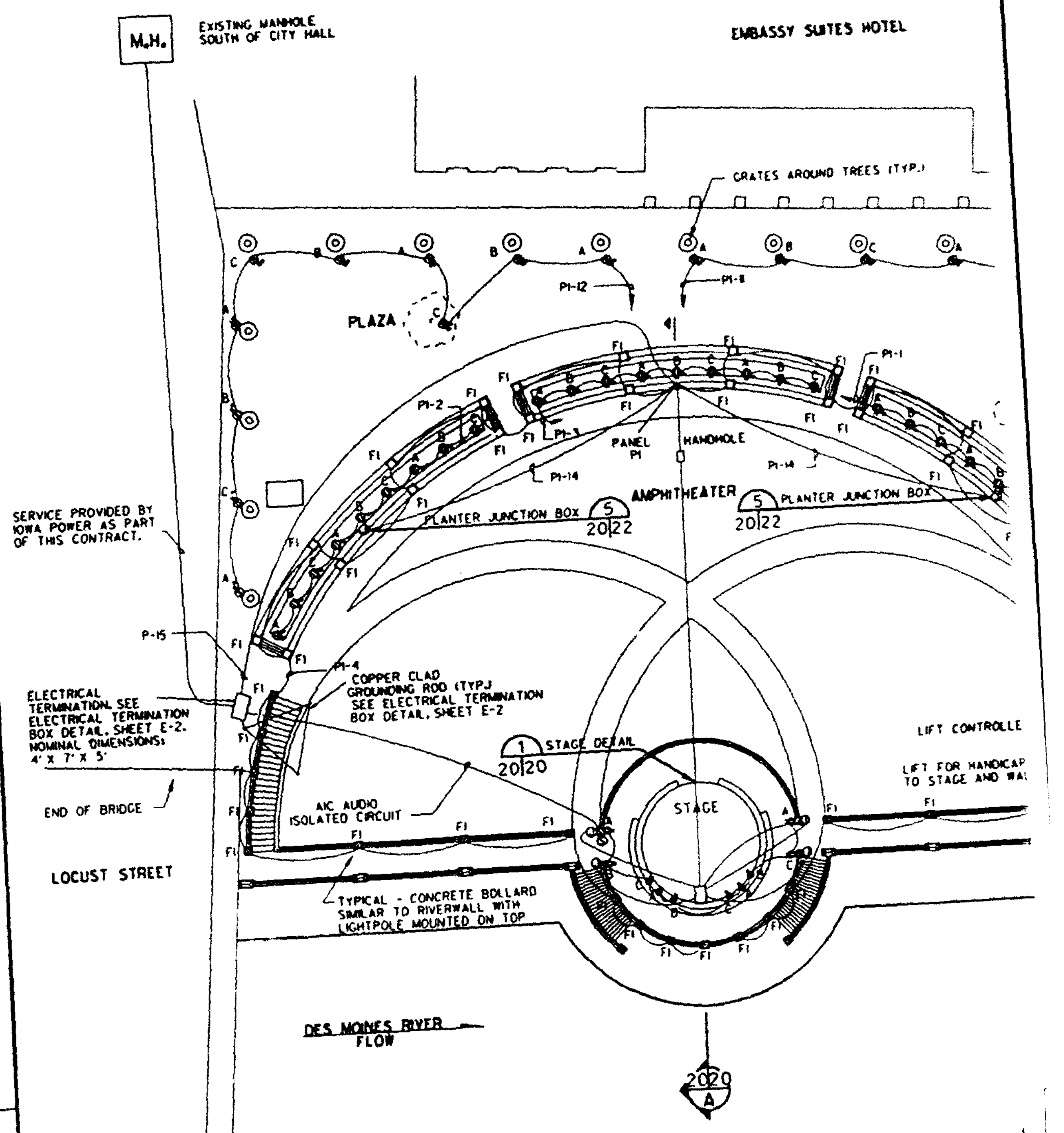
- ● 50 PSI. 30'-0" RADIUS. FULL CIRCLE SPRINKLER HEAD
- ◓ 50 PSI. 30'-0" RADIUS. HALF CIRCLE SPRINKLER HEAD
- ■ 20 PSI. FLOOD BUBBLER FOR PLAZA TREES
- ■ 10 PSI. 4" POP-UP BUBBLER FOR SHRUBS IN PLANTERS
- —— CLASS 200 PVC 1/2" TO 2" DIAMETER
- ▬ IN WALL HYDRANT
- ◎ DRINKING FOUNTAIN

3053

Revisions			
Symbol	Description	Date	Approved

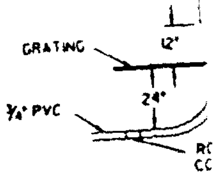
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by:	US Army Corps of Engineers — DES MOINES RECREATIONAL RIVER AND GREENBELT DOWNTOWN RIVERFRONT PLAZA/AMPHITHEATER
Drawn by:	
Checked by:	DRAINAGE AND IRRIGATION SITE PLAN
Reviewed by:	Scale: AS SHOWN / Sheet reference number: M-1 / File Number: GB04\GB04M001
Approved by:	Date: / Drawing Code: / Solicitation Number: DACW25-9 -B- / Sheet of



ELECTRICAL SITE PLAN

SCALE: 1"=20'

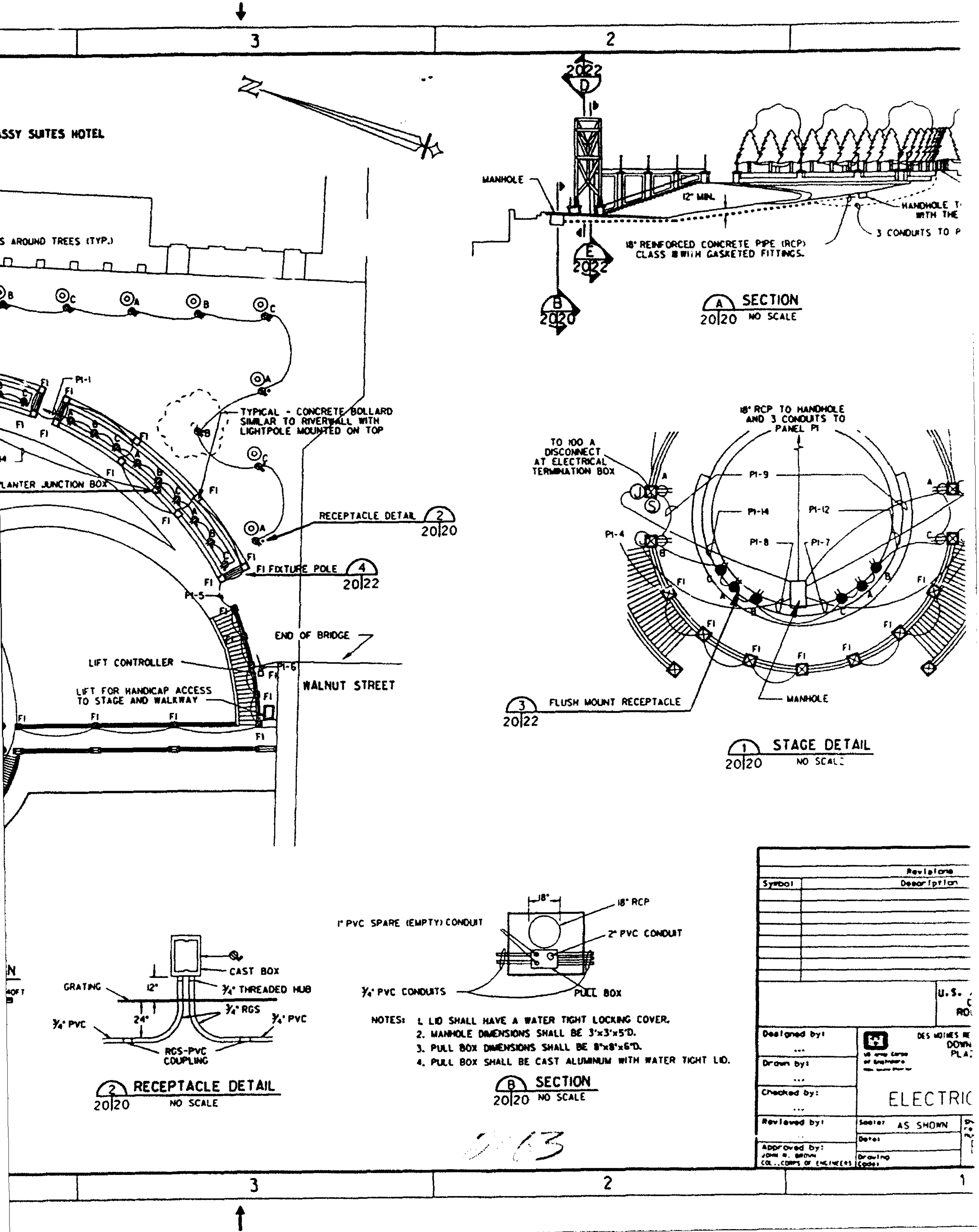


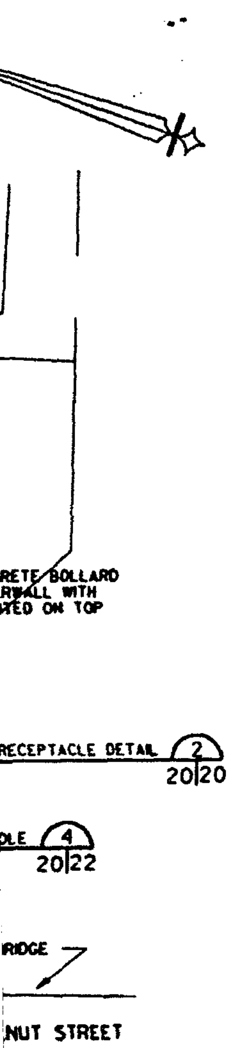
2 RECEP
20|20

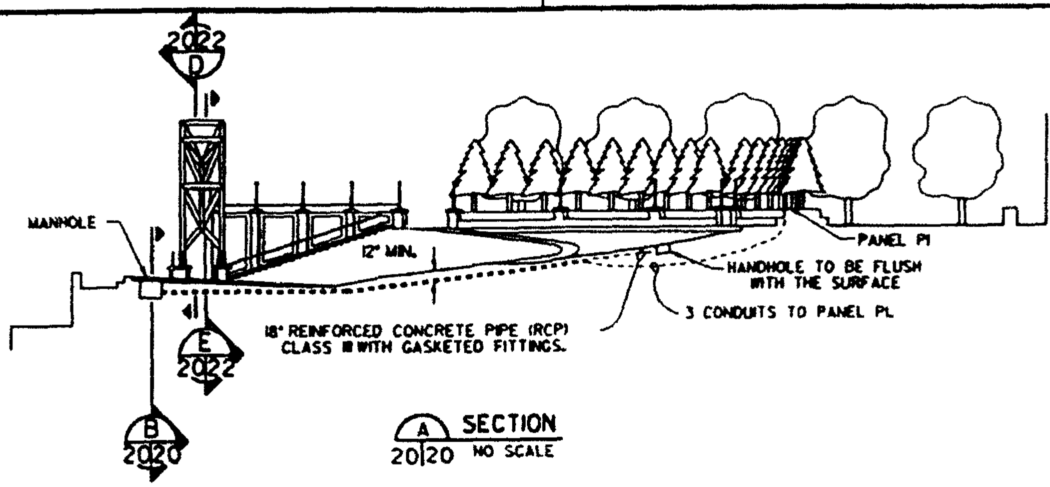
GENERAL NOTES:

1. ALL RECEPTACLES SHALL BE GROUND FAULT INTERRUPTING (G.F.I.) SPECIFICATION OR HOSPITAL GRADE COMPLETE WITH LOCKABLE COVERS UL LISTED AND INSTALLED FOR WET LOCATIONS WHILE IN USE.
2. LETTERS A, B AND C INDICATE CIRCUIT PHASING.
3. ALL BURIED RGS CONDUIT SHALL BE WRAPPED WITH VINYL PIPE WRAP.
4. PHOTO ELECTRIC CELL SHALL FACE NORTH
5. ALL WIRING IS SHOWN DIAGRAMATICALY AND MAY NOT REPRESENT EXACT ROUTE
6. PANEL P1 SHALL BE NEMA 3R

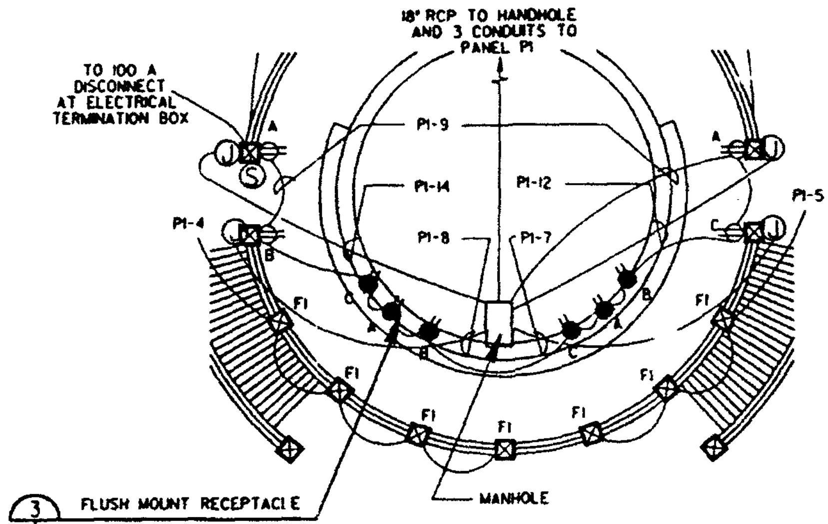
1043


3
2
1
ASSY SUITES HOTEL
S AROUND TREES (TYP.)
PI-1
F1
TYPICAL - CONCRETE BOLLARD SIMILAR TO RIVERWALL WITH LIGHTPOLE MOUNTED ON TOP
PLANTER JUNCTION BOX
RECEPTACLE DETAIL 2 20|20
F1 FIXTURE POLE 4 20|22
PI-5
END OF BRIDGE
LIFT CONTROLLER
PI-6
WALNUT STREET
LIFT FOR HANDICAP ACCESS TO STAGE AND WALKWAY
MANHOLE
12" MIN.
HANDHOLE T WITH THE
3 CONDUITS TO P
18" REINFORCED CONCRETE PIPE (RCP) CLASS III WITH GASKETED FITTINGS.
A SECTION 20|20 NO SCALE
18" RCP TO HANDHOLE AND 3 CONDUITS TO PANEL PI
TO 100 A DISCONNECT AT ELECTRICAL TERMINATION BOX
PI-9
PI-14
PI-12
PI-4
PI-8
PI-7
3 FLUSH MOUNT RECEPTACLE 20|22
MANHOLE
1 STAGE DETAIL 20|20 NO SCALE
CAST BOX
GRATING
12"
3/4" THREADED HUB
3/4" RGS
3/4" PVC
24"
RGS-PVC COUPLING
2 RECEPTACLE DETAIL 20|20 NO SCALE
18"
18" RCP
1" PVC SPARE (EMPTY) CONDUIT
2" PVC CONDUIT
3/4" PVC CONDUITS
PULL BOX
NOTES: 1. LID SHALL HAVE A WATER TIGHT LOCKING COVER.
2. MANHOLE DIMENSIONS SHALL BE 3'x3'x5'D.
3. PULL BOX DIMENSIONS SHALL BE 8"x8"x6"D.
4. PULL BOX SHALL BE CAST ALUMINUM WITH WATER TIGHT LID.
B SECTION 20|20 NO SCALE
Revisions
Symbol
Description
U.S.
Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by: JOHN R. BROWN COL., CORPS OF ENGINEERS
DES MOINES
ELECTRIC
Scale: AS SHOWN
Date:
Drawing Code:

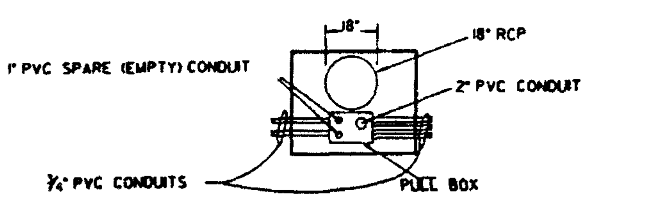




A SECTION 20|20 NO SCALE



1 STAGE DETAIL 20|20 NO SCALE



NOTES:
1. LID SHALL HAVE A WATER TIGHT LOCKING COVER.
2. MANHOLE DIMENSIONS SHALL BE 3'x3'x5'D.
3. PULL BOX DIMENSIONS SHALL BE 8"x8"x6"D.
4. PULL BOX SHALL BE CAST ALUMINUM WITH WATER TIGHT LID.

B SECTION 20|20 NO SCALE

383

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: ...
Drawn by: ...
Checked by: ...
Reviewed by: ...
Approved by: JOHN R. BROWN COL., CORPS OF ENGINEERS

DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

ELECTRICAL PLAN

Scale: AS SHOWN
Date:
Drawing Code:
Sheet reference number: E-1
Solicitation Number: DACW25-9 -B-
Sheet of

PLATE 20

5 4

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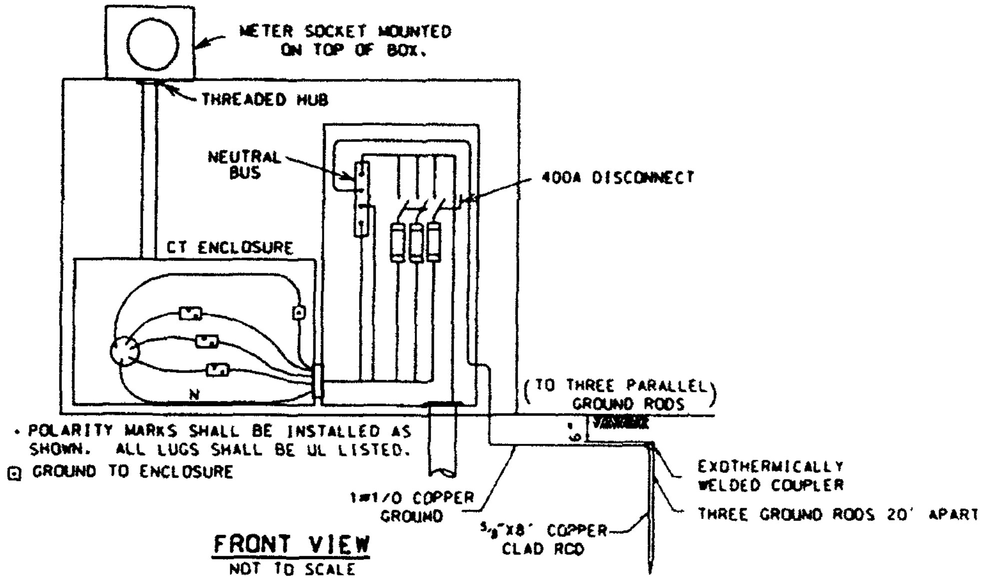
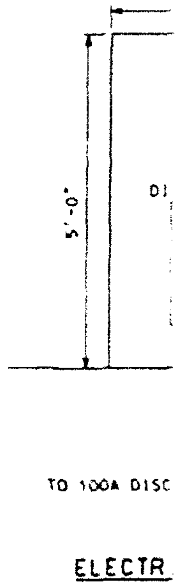


FRONT VIEW
NOT TO SCALE



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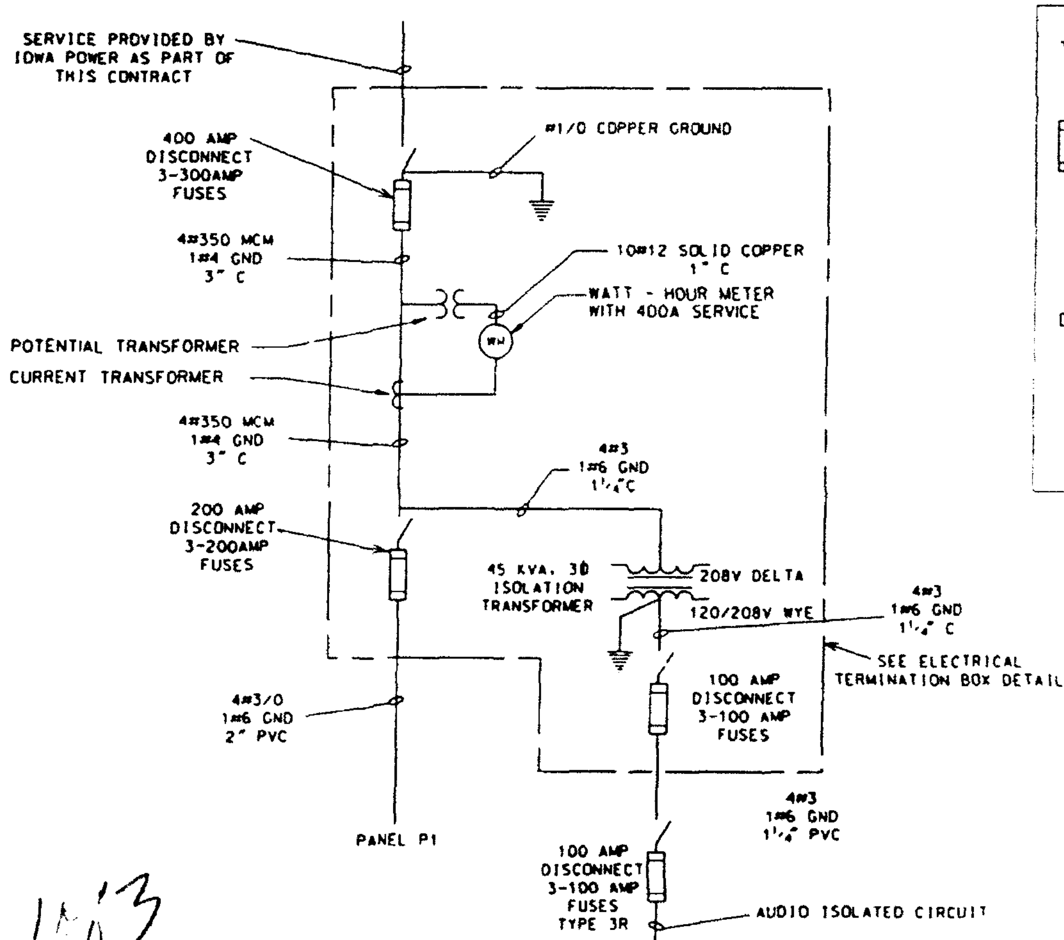

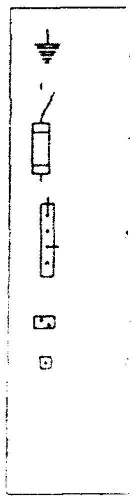

B

A

1503

ONE LINE POWER DIAGRAM
NO SCALE

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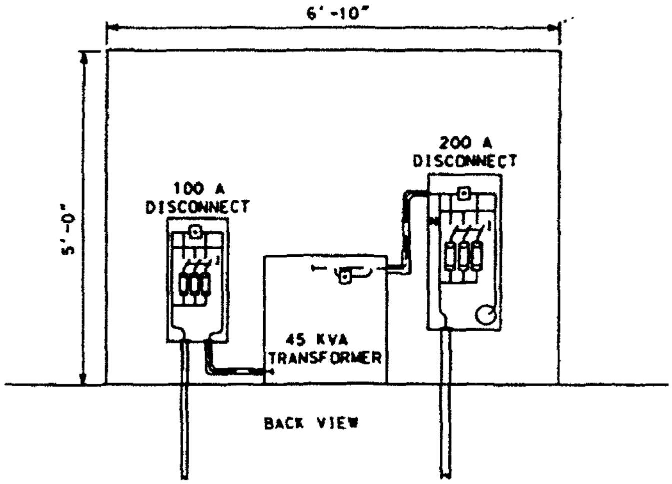

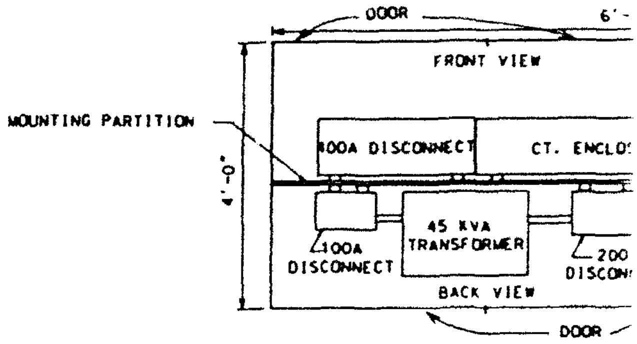

PLAN VIEW
NOT TO SCALE

PART

ELECTRICAL TERMINATION BOX DETAIL
NOT TO SCALE

GROUND	20 AMP SURFACE MOUNT DUPLEX RECEPTACLE
FUSE	20 AMP FLUSH MOUNT DUPLEX RECEPTACLE
	20 AMP FSS DUPLEX RECEPTACLE
NEUTRAL BUS	JUNCTION BOX
	DISCONNECT
BAR TYPE CURRENT TRANSFORMER	JUNCTION BOX IN ARCH
GROUND TO ENCLOSURE	20 AMP DUPLEX RECEPTACLE IN ARCH

LEGEND
NO SCALE

PANEL SYMBOL P1
TYPE BRKS. BOLT ON
MOUNTING TYPE SURFACE
MAIN BUS 225 A

NO
3

CKT NO.	DESCRIPTION	WIRE SIZE	L1 L2 L3	WIRE SIZE
1	SOUTH RECEPTACLES	10	20 20	10
3	SOUTH RECEPTACLES	10	20 20	10
5	SOUTH RECEPTACLES	10	20 20	10
7	CENTER RECEPT.S	10	20 20	10
9	CENTER RECEPT.S	10	20 20	10
11	CENTER RECEPT.S	10	20	10
13	ARCH JUNCTION BOX	8	30 20	10
15			1 20	10
17			20 20	10
19	SOUTH TREE RECPT	10	20 20	10
21	SOUTH TREE RECPT	10	20 20	10
23	SOUTH TREE RECPT	10	20 20	10
25	WHEELCHAIR	6		
27				
29	F. ARCH RECEPT.	10	20 60	
* 31	N PARAMETER LGHTS	12		
33			1	
35			20 20	
37	SPARE		20	
39	24 V DC SOURCE		20	
41	24 V DC SOURCE			

* =20 A 2-POLE REMOTE CONTROL BREAKER (3 SPACES)

4#3
1#6 GND
1¼" C
SEE ELECTRICAL
INATION BOX DETAIL

LINE	VOLTS	FROM	TO	CONDUCTOR/GND	CONDUIT	CIRCUIT
P1-1	120	P1	SOUTH RECEPT.	6#10.3#10	¾"PVC	1.3.5
P1-2	120	P1	NORTH RECEPT.	6#10.3#10	¾"PVC	2.4.6
P1-3	120	P1	CENTER RECEPT.	6#10.3#10	¾"PVC	7.9.11
P1-4	208	P1	NORTH LIGHTS	2#12.1#12	¾"PVC	31.33
P1-5	208	P1	SOUTH LIGHTS	2#12.1#12	¾"PVC	26.28
P1-6	208	P1	WHEELCHAIR LIFT	2#6.1#10	1 "PVC	25.27
P1-7	208	P1	ARCH JB	4#8.1#10	1 "PVC	13.15.17
P1-8	120	P1	REAR ARCH RECEPT.	6#10.3#10	¾"PVC	8.10.12
P1-9	120	P1	REAR STAGE RECEPT.	6#10.3#10	¾"PVC	14.16.18
P1-10	120	P1	NORTH TREE RECEPT.	6#10.3#10	¾"PVC	20.22.24
P1-11	120	P1	SOUTH TREE RECEPT.	6#10.3#10	¾"PVC	19.21.23
P1-12	120	P1	PHOTO-ELECTRIC CELL	3#12.1#12	¾"PVC	26.31
P1-13	120	P1	FRONT ARCH RECEPT.	2#10.1#10	¾"PVC	29
*P1-14	208	P1	JB ON PERIMETER	3#6.1#8	¾"PVC	
*P1-15	208	ELECTRIC TERMINATION BOX	P1	3#4/0.1#6	2"PVC	
AIC	208	ELECTRIC	100 AMP DISCONNECT	4#3.1#6	1¼"PVC	

* NOT TO BE TERMINATED ON P1. TO BE LEFT AS SPARE

ED CIRCUIT

2063

Revisions	
Symbol	Description

U.S.
R

Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by:

US Army Corps of Engineers

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Scale: AS SHOWN
Date:
Drawing Code:

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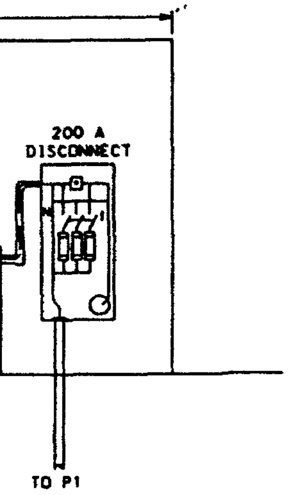
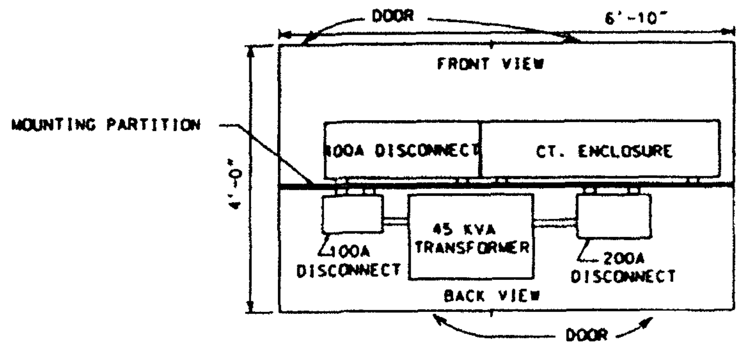
2	1



ON BOX DETAIL



PLAN VIEW
NOT TO SCALE

PANEL SYMBOL P1

TYPE BRKS. BOLT ON — NONE MAIN BRKR.
MOUNTING TYPE SURFACE — 208Y/120 VOLTS
MAIN BUS 225 A — 3 PHASE, 4 WIRE,

CKT NO.	DESCRIPTION	WIRE SIZE	L1 L2 L3	WIRE SIZE	DESCRIPTION	CKT NO.
1	SOUTH RECEPTACLES	10		10	NORTH RECEPTACLES	2
3	SOUTH RECEPTACLES	10		10	NORTH RECEPTACLES	4
5	SOUTH RECEPTACLES	10		10	NORTH RECEPTACLES	6
7	CENTER RECEPT.S	10		10	R ARCH RECEPT.	8
9	CENTER RECEPT.S	10		10	R ARCH RECEPT.	10
11	CENTER RECEPT.S	10		10	R ARCH RECEPT.	12
13	ARCH JUNCTION BOX	8		10	R STAGE RECEPT.	14
15				10	R STAGE RECEPT.	16
17				10	R STAGE RECEPT.	18
19	SOUTH TREE RECPT	10		10	NORTH TREE RECPT	20
21	SOUTH TREE RECPT	10		10	NORTH TREE RECPT	22
23	SOUTH TREE RECPT	10		10	NORTH TREE RECPT	24
25	WHEELCHAIR	6			S PARAMETER LGHTS	26 *
27						28
29	F. ARCH RECEPT.	10				30
* 31	N PARAMETER LGHTS	12			SPARE	32
33						34
35						36
37	SPARE				SPARE	38
39	24 V DC SOURCE				SPARE	40
41	24 V DC SOURCE				SPARE	42

* =20 A 2-POLE REMOTE CONTROL BREAKER (3 SPACES)

	20 AMP SURFACE MOUNT DUPLEX RECEPTACLE
	20 AMP FLUSH MOUNT DUPLEX RECEPTACLE
	20 AMP FSS DUPLEX RECEPTACLE
J	JUNCTION BOX
S	DISCONNECT
	JUNCTION BOX IN ARCH
	20 AMP DUPLEX RECEPTACLE IN ARCH

SFORMER

EGEND
SCALE

OM	TO	CONDUCTOR/GND	CONDUIT	CIRCUIT
P1	SOUTH RECEPT.	6#10.3#10	3/4"PVC	1.3.5
P1	NORTH RECEPT.	6#10.3#10	3/4"PVC	2.4.6
P1	CENTER RECEPT.	6#10.3#10	3/4"PVC	7.9.11
P1	NORTH LIGHTS	2#12.1#12	3/4"PVC	31.33
P1	SOUTH LIGHTS	2#12.1#12	3/4"PVC	26.28
P1	WHEELCHAIR LIFT	2#6.1#10	1 "PVC	25.27
P1	ARCH JB	4#8.1#10	1 "PVC	13.15.17
P1	REAR ARCH RECEPT.	6#10.3#10	3/4"PVC	8.10.12
P1	REAR STAGE RECEPT.	6#10.3#10	3/4"PVC	14.16.18
P1	NORTH TREE RECEPT.	6#10.3#10	3/4"PVC	20.22.24
P1	SOUTH TREE RECEPT.	6#10.3#10	3/4"PVC	19.21.23
P1	PHOTO-ELECTRIC CELL	3#12.1#12	3/4"PVC	26.31
P1	FRONT ARCH RECEPT.	2#10.1#10	3/4"PVC	29
P1	JB ON PERIMETER	3#6.1#8	3/4"PVC	
TRIC	P1	3#4/0.1#6	2"PVC	
TION BOX TRIC	100 AMP DISCONNECT	4#3.1#6	1 3/4"PVC	

3/13

TED ON P1. TO BE LEFT AS SPARE

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: . . .
Drawn by: . . .
Checked by: . . .
Reviewed by:
Approved by: . . .

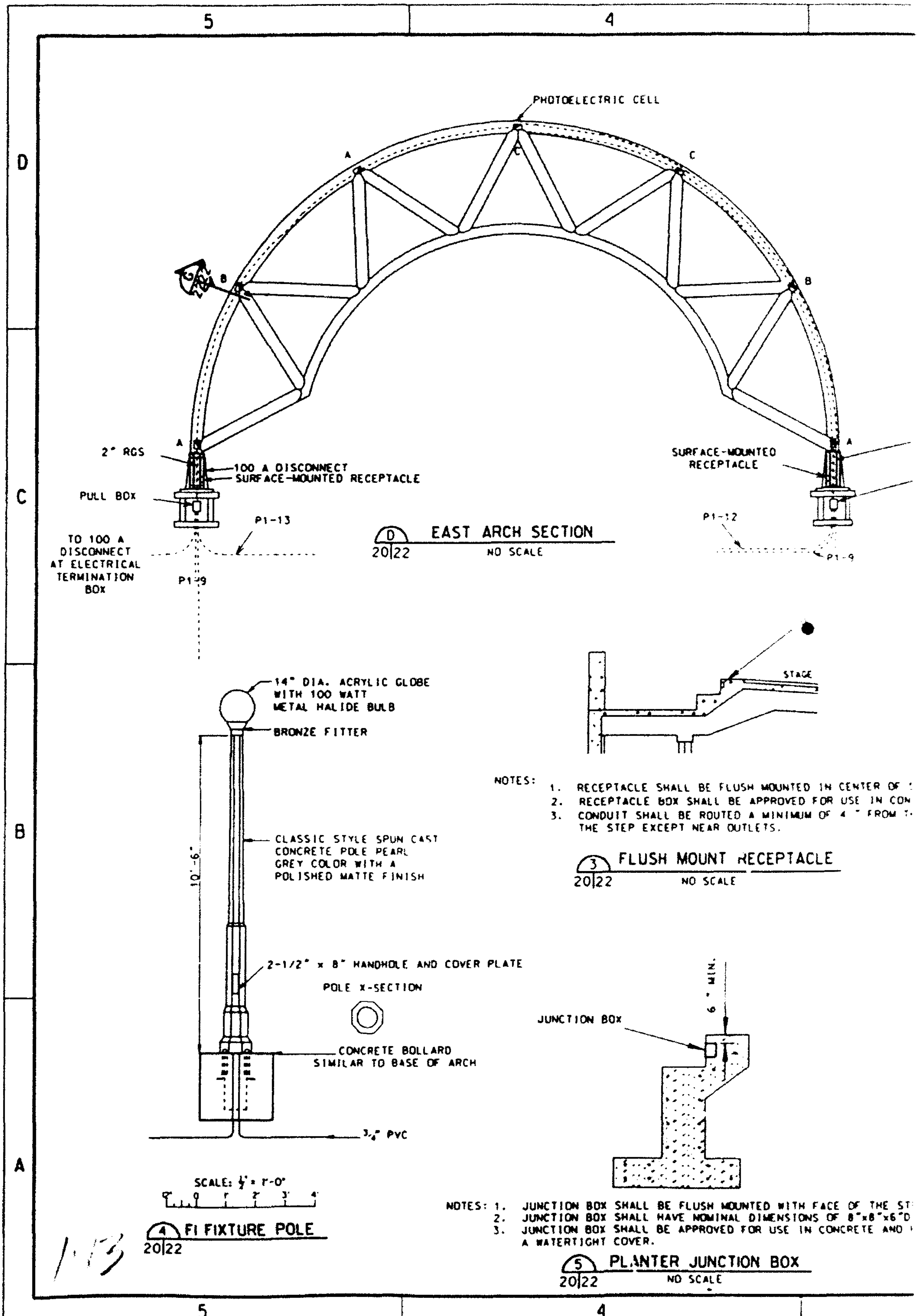
US Army Corps of Engineers

DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

ELECTRICAL DETAILS

Scale: AS SHOWN
Date:
Drawing Code:
Sheet reference number: E-2
Solicitation Number: DACW25-9 -B-
Sheet of

2	1



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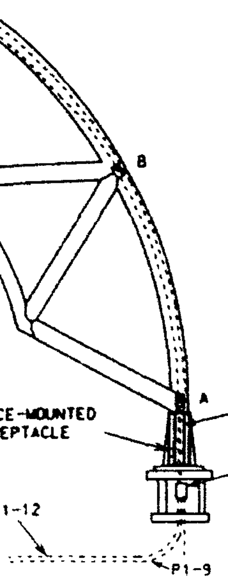
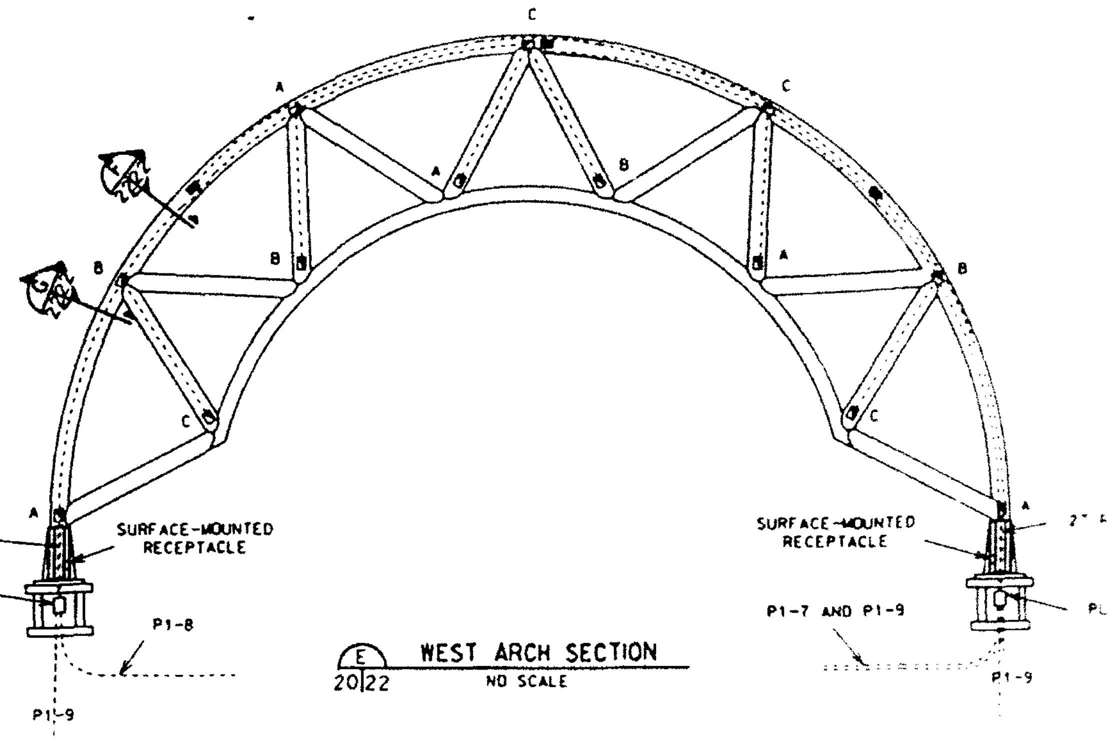
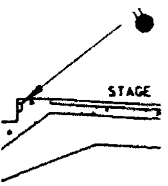




E WEST ARCH SECTION
20|22 NO SCALE

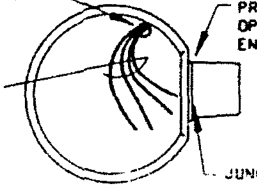
NOTES:

1. PULL BOX SHALL HAVE NOMINAL DIMENSIONS OF 6" X 6" X 3" FLAT FLANGED AND FLUSH MOUNTED ON THE POST.



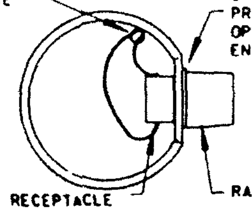
. FLUSH MOUNTED IN CENTER OF STEP.
.L BE APPROVED FOR USE IN CONCRETE.
JUTED A MINIMUM OF 4 " FROM THE FACE OF
AR OUTLETS.

NT RECEPTACLE
CALE



DETAIL SHOWS TYPICAL DESIGN FOR ALL 3 LOCATIONS

F JUNCTION BOX SECTION
22|22 NO SCALE



G OUTLET SECTION
22|22 NO SCALE

I MOUNTED WITH FACE OF THE STEP.
IINAL DIMENSIONS OF 8"x8"x6"D.
IVED FOR USE IN CONCRETE AND HAVE

NCTION BOX
.E

•A •B •C
INDICATES A 8" X 6" FLATTENED SPOT WITH A 4¹¹⁄₁₆" X 2⁷⁄₈" HOLE CUT IN THE CENTER OF THE FLATTENED SPOT.
INSTALL RECEPTACLES WITH COVERPLATES RATED WET LOCATION WHILE IN USE.

Symbol	Revision Description

Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by: JOHN R. BROWN COL., CORPS OF ENGINEERS

US Army Corps of Engineers

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Scale: AS SHOWN
Date:
Drawing Code:

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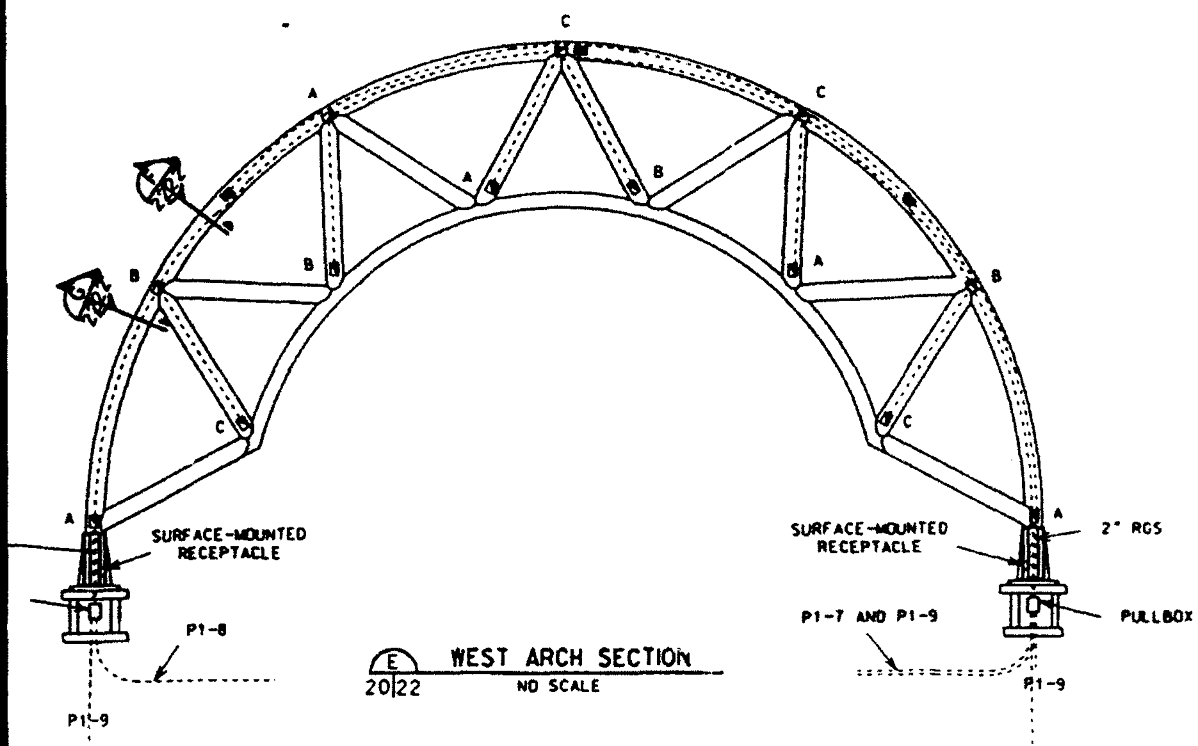
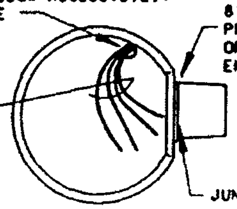


E 20|22 WEST ARCH SECTION
NO SCALE

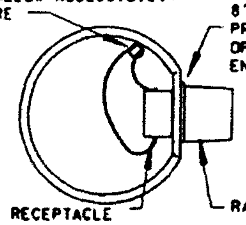
NOTES:

1. PULL BOX SHALL HAVE NOMINAL DIMENSIONS OF 8" X 6" X 3". LID IS TO BE FLAT FLANGED AND FLUSH MOUNTED ON THE POST.



DETAIL SHOWS TYPICAL DESIGN FOR ALL 3 LOCATIONS

F 22|22 JUNCTION BOX SECTION
NO SCALE



G 22|22 OUTLET SECTION
NO SCALE

3063

A B C
INDICATES A 8" X 6" FLATTENED SPOT WITH A $4\frac{11}{16}$" X $2\frac{5}{16}$" HOLE CUT IN THE CENTER OF THE FLATTENED SPOT.
INSTALL RECEPTACLES WITH COVERPLATES RATED WET LOCATION WHILE IN USE.

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

DES MOINES RECREATIONAL RIVER AND GREENBELT
DOWNTOWN RIVERFRONT
PLAZA/AMPHITHEATER

ELECTRICAL DETAILS

Designed by:
Drawn by:
Checked by:
Reviewed by:
Approved by: JOHN R. BROWN COL., CORPS OF ENGINEERS

Scale: AS SHOWN
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Sheet of